DRAFT
FREELAND COMPREHENSIVE DRAINAGE PLAN

VOLUME 1

May 2005

Prepared for:
Surface Water Management
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PW-012003
WO 373

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The community of Freeland is an unincorporated area that is designated a rural area of intensive development (RAID) in the current GMA Comprehensive Plan. It consists of a core business district that has developed along Main Street and S.R. 525, platted sub-divisions and rural residential housing, as well as, rural areas. As development has occurred, the increased volume and rate of stormwater runoff has resulted in localized flooding. As a consequence, the Freeland business area and the West Freeland area were designated Critical Drainage Areas in 1998.

The current RAID designation will not allow for expansion of the Freeland RAID beyond what existed before July 1, 1990. To provide for local control of continued growth, the Freeland Sub Area Planning Committee is pursuing a non-municipal Urban Growth Area (NMUGA) designation for the community of Freeland. Island County Public Works commissioned the Freeland Comprehensive Drainage Plan (*Plan*), in part, to meet the comprehensive stormwater planning requirements to support the NMUGA designation, as well as, provide a planning tool for Public Works to identify and prioritize surface water requirements and projects within the Freeland Basin through a 20-year planning window. This document focuses on the following areas:

1. Evaluation of the existing stormwater infrastructure through hydrologic modeling, field verification, and interviews with Island County staff to identify and prioritize existing stormwater flooding issues based on current land use designations.
2. Modeling the existing stormwater infrastructure based on future land use (proposed NMUGA zoning) and anticipated full build out to identify infrastructure improvements necessary to meet future needs.
3. Identifying water quality issues associated with stormwater conveyance and discharge and making recommendations to preserve and protect water quality discharged to wetlands and to Holmes Harbor.
4. Preparing costs estimates for these improvements and presenting a capital improvement plan for the recommended improvements.

Two previous studies identified stormwater flooding issues in the Freeland area and provided recommended solutions.

- *Freeland Community Drainage Basin Study*, Alpha Engineers Inc., 1985.
- *Island County Comprehensive Stormwater and Flood Hazard Management Plan*, KCM, Inc., 1997.

Island County Public Works completed three major stormwater infrastructure projects between 2000 and 2004 that have alleviated the major flooding issues identified in these previous drainage studies. These projects include:

1. The Ships Haven Drive drainage improvements and 24-inch outfall.
2. The Shoreview Drive drainage improvements and outfall vault.
3. The Freeland Park Outfall project, which included construction of over 3,000 feet of storm drain that discharges to a new outfall vault in the Freeland Park.

The *Plan* identified three major drainage basins within the Freeland planning area that discharge to Holmes Harbor, designated simply as the West, Central and East Basins. Hydrologic modeling for the 25- and 100-year storm events (return period) indicates that the stormwater infrastructure, currently in place in the West and Central Basins, is sufficient to meet the existing conditions with current land use designation. The East Basin drains to Holmes Harbor through two culverts under East Harbor Road and then overland across private property; there is no stormwater outfall serving the basin. Further development under the current land use designation will likely result in flooding of downstream bluff properties. In addition, there is a remaining phase of the Freeland Park Outfall project yet to be completed which includes stream enhancement of unnamed stream #06-0010, north of the Freeland Plaza shopping center. Problem identification for future conditions is summarized below:

1. Hydrologic modeling of the future land use designation, using a full build out scenario, revealed potential flooding problems.
2. Interviews with Island County Road District personnel identified additional structural improvements that are necessary to alleviate flooding.
3. Improving and upgrading the existing stormwater infrastructure will alleviate these problems.

Table 1 summarizes stormwater projects required to meet existing and future conditions and the estimated costs in 2005 dollars.

	Description	Cost	Priority
1	Phase 2 Freeland Park Outfall	$115,100	6-year
2	East Harbor Rd – Construct 18-inch Outfall & Storm Drain	$275,000	6-year
3	East Harbor Rd – Upsize Culvert	$9,200	6-year
4	East Harbor Rd – 630 LF 18-inch Storm Drain	$96,600	6-year
5	East Harbor Rd – Construct Bio-filtration Swale	$14,000	6-year
	Subtotal	**$509,900**	---
6	Shoreview Dr. - Replace Outfalls & Tide Gates	$58,800	20-year
7	Woodard Ave. – Upsize Culvert	$9,200	20-year
8	Main St. – Upsize Culvert	$12,100	20-year
9	Bercot Rd. – Combine Existing Outfalls into Single 18-inch Outfall	$77,000	20-year
10	Cameron Rd. –140 LF of 18-inch Storm Drain	$23,400	20-year
11	Ditch Improvements - S.R. 525 to Cameron Rd	$19,300	20-year
12	Cameron Rd. N. of S.R. 525 – 200 LF of 18-inch Storm Drain & Ditch Improvements	$48,400	20-year
13	Cameron Rd. S. of S.R. 525 – 700 LF of 18-inch Storm Drain & Ditch Improvements	$85,400	20-year
14	Pleasant View – Relocate and Upsize Culvert	$18,100	20-year
15	Fish Rd. - Construct Bio-filtration Swale	$12,300	20-year
16	Fish Rd. - Upsize Culvert	$9,200	20-year
	Subtotal	**$373,200**	---
	Total	**$883,100**	---

Table 1. Capital Improvements Projects

A qualitative wetland analysis of four wetlands in the Freeland area was completed by Adolfson and Associates. Water quality studies were completed in the Central basin by Herrera Environmental Consultants to support the Freeland Park Outfall project design. Based on these reports and conclusions drawn from the *Plan*, the following recommendations are made:

- It is recommended that Island County pursue grant funding for a microbial source tracking study to identify the source of fecal coliform contamination in stormwater runoff within the Central basin.
- Further studies are necessary to evaluate the estuarine wetland located southwest of the intersection of Shoreview Drive and Woodard Avenue (identified as Wetland 4 in the *Plan*). The Department of Fish and Wildlife has expressed an interest in having the existing outlet pipe and tide gate replaced with an open channel culvert or larger fish passable tide gate. Detailed analysis is required to determine the potential effects an open channel culvert may have on habitat and flooding issues.
- The *Plan* identified subbasin N-18 as an area within the proposed NMUGA that drains to the closed depression bounded by Scott, Newman and Double Bluff

Roads (identified as Wetland 5 in the *Plan*). This closed depression drains an area of over 500 acres that lies outside of the study area. A closed depression analysis is necessary to determine detention requirements for parcels within N-18 before these properties are allowed to develop at greater densities and discharge to this wetland.

- Basin W-19 lies south of S.R. 525 and west of Cameron Road. Stormwater runoff in this subbasin drains south toward Mutiny Bay. In researching potential downstream impacts, Island County Road District personnel indicated that there are ongoing flooding problems in the Mutiny Bay and Lancaster Road drainage basins. It appears that stormwater runoff quantity and water quality in subbasin W-19 can be mitigated through on-site infiltration. It is recommended, however, that a drainage study be commissioned to evaluate the drainage issues within the Mutiny Bay and Lancaster Road basins.
- The East basins should be designated a Critical Drainage Area until a stormwater outfall is constructed and the two East basins are connected hydraulically so that stormwater runoff from both basins can be conveyed to the new outfall.
- Based on hydrologic analysis, it is recommended that the Critical Area designation be lifted for West Freeland and the Business District; the east boundary of which is located approximately 700 feet east of Harbor Avenue (the beginning of the 18-inch PVC storm drain on E. Main Street).

SECTION 1.0 - INTRODUCTION

1.1 Purpose

The community of Freeland is an unincorporated area within Island County, which historically has experienced a greater intensity of residential and commercial development than the predominantly rural surrounding areas within the county. As development continues to occur within the Freeland Area, the increase in the amount of land covered by impervious surfaces associated with a developed landscape and the corresponding decrease in natural, vegetated land will increase the speed and volume of stormwater flows entering the existing stormwater conveyance system. In the process of planning for future growth, the need has arisen to provide a comprehensive evaluation of current and future storm drainage issues and an identification of areas, which require improvement or which may pose a constraint to future development. The purpose of this study is to provide recommendations for drainage capital improvements that will support local planning goals for the community. The purpose is achieved by way of a technical analysis and field documentation of the existing public stormwater conveyance system in the study area.

The general goals and objectives for this study area are to:

- Provide an analysis of the existing drainage conditions within the Freeland Area.
- Recommend improvements to the existing stormwater conveyance system to correct existing stormwater conveyance problems.
- Recommend improvements to the existing stormwater conveyance system to correct anticipated problems caused by future development.
- Recommend improvements to the existing stormwater conveyance system that would improve water quality.
- Estimate the costs associated with recommended alternatives for improvements to the stormwater conveyance system within the Freeland Area.
- Incorporate input from the public and state and local reviewing agencies into a final plan for stormwater capital facility improvements.

1.2 Authorization and Coordination

Preparation of this Comprehensive Stormwater Management Plan was authorized by Island County through a contract agreement with Fakkema & Kingma, Inc. dated January 22, 2001, as amended in Supplemental Agreement No.1 dated May 24, 2004 and Supplemental Agreement No. 2 dated March 21, 2005. This document is intended to be reviewed by and is prepared in coordination with Island Public Works and Planning Staff, the Freeland Sub-Area Planning Committee, State Resource Agencies (including the Washington State Department of Ecology (DOE) and the Washington State Department of Fish and Wildlife (WDFW)), as well as the general public.

1.3 Scope of Work

The scope of work developed for this project was included with the original contractual agreement with Island County Department of Public Works (WO 373). The general requirement of this scope included necessary research, field surveying, mapping and associated field work in support of preparation of a preliminary comprehensive plan for the Freeland Basin. Prior to completion of the preliminary document for review by applicable local agencies and the general public, a final stormwater plan will be prepared which incorporates all public and agency comment and guidance provided. This plan is to define the capital facility improvements within the Freeland Basin Planning Area if Freeland is to become a non-municipal Urban Growth Area (NMUGA).

1.4 Public Involvement

The Draft Comprehensive Drainage Plan is intended to be reviewed and presented to the public through a series of public meetings.

Future Public Meetings regarding this subject will:

- Provide a general overview of the goals, objectives, and methodology included within this study.
- Define known problems or constraints to the stormwater conveyance system within the Freeland Area.
- Receive public input regarding specific or localized drainage problems.
- Receive public input on preferences for stormwater conveyance improvements.
- Discuss ways to incorporate public input into the Final Comprehensive Drainage Plan.

Note: The *Draft Freeland Comprehensive Drainage Plan* consists of two volumes. Volume 1 contains the *Draft Freeland Comprehensive Drainage Plan*. Volume 2 is the *Appendix*, which contains detailed hydrologic modeling results. Because of its size and technical content, Volume 2 was not distributed for general review. If a copy is desired, contact the Island County Stormwater Manager, Phil Cohen, at Island County Public Works.

1.5 Previous Studies

- *Freeland Community Drainage Basin Study*, Alpha Engineers Inc., 1985.
- *Island County Comprehensive Stormwater and Flood Hazard Management Plan*, KCM, Inc., 1997.
- *Freeland Outfall Wetland Delineation Report*, Sheldon and Associates, 2001.

1.6 Implementation

The completion and implementation of recommended improvements may be dependent on the following factors:

- Acceptance of the recommended improvements by the Island County Board of County Commissioners.
- Approval of funding sources by action of the Island County Board of County Commissioners.
- Adoption of specific County Ordinances and Planning Documents as they pertain to the Freeland Sub-area.

SECTION 2.0 - DESCRIPTION OF THE STUDY AREA

2.1 Study Area

The study area is the community of Freeland located in the southern portion of Whidbey Island in Island County, Washington. The study area boundaries represent a topographic or drainage divide between adjacent watersheds. The Freeland study area is comprised of three distinct drainage basins that drain to Holmes Harbor. These basin boundaries generally exceed the sub area planning boundaries for the proposed non-municipal Urban Growth Area (NMUGA) for the community of Freeland with the exception of two areas. In the West Basin there is a 65.7-acre area (W-19 Offsite) that lies west and south of Cameron Road that is included in the NMUGA but drains southwest toward Mutiny Bay. In the Central Basin there is a 29.1-acre area (N-18 Offsite) that lies east of the drainage divide but within the NMUGA. This area drains east to the closed depression (wetland) between Scott and Newman Roads. The study area totals approximately 1,500 acres, while the NMUGA includes 900 acres.

Figure 2-1 depicts both the study area and the NMUGA boundaries. It should be noted that the Holmes Harbor Golf & Yacht Club was the subject of a separate drainage study (*Holmes Harbor Drainage Study, 2000*) and was not included in the study area even though it lies within the proposed NMUGA.

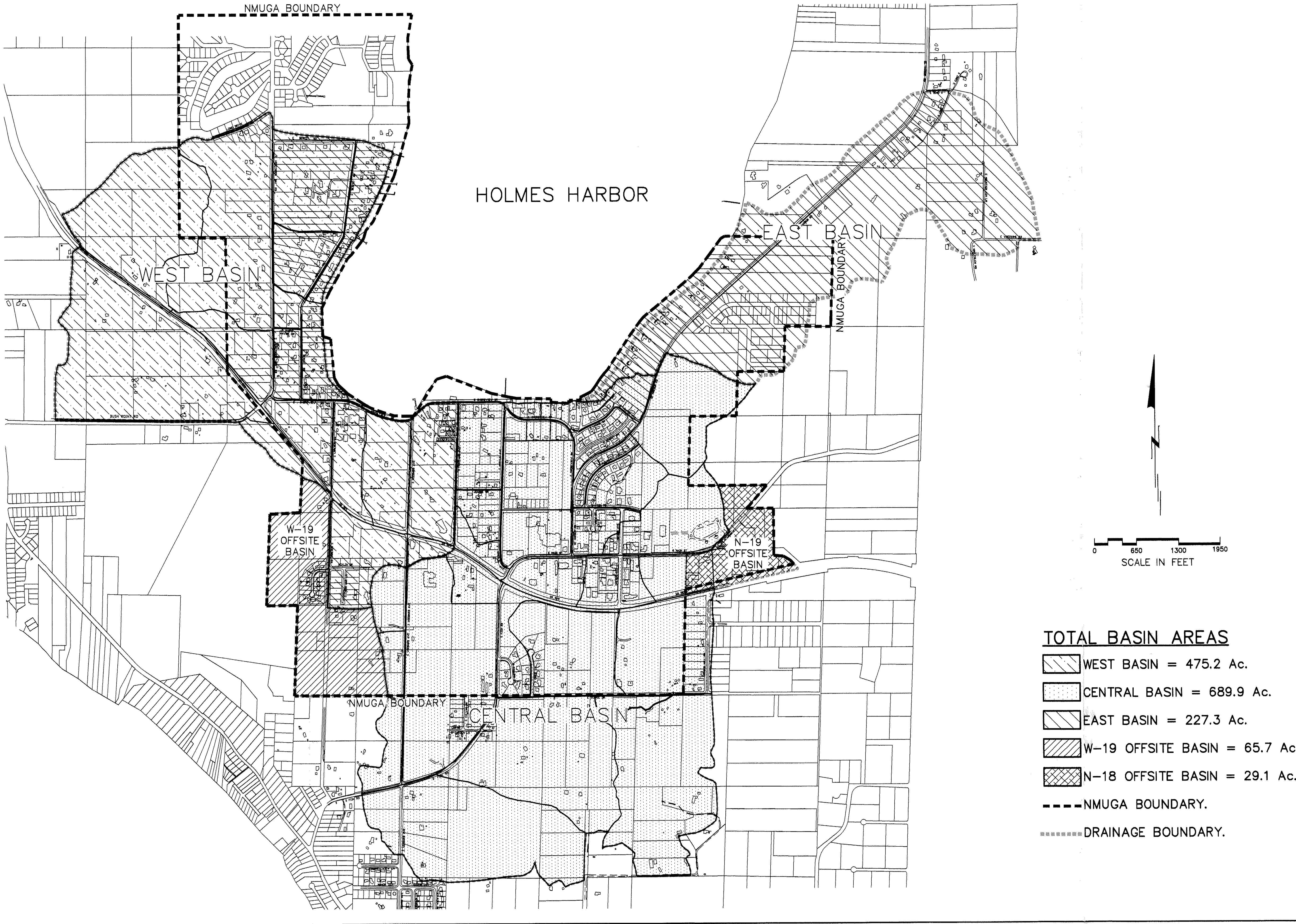


FIGURE 2-1
FREELAND DRAINAGE BASIN MAP
1" = 1300'

2.2 Climate

The climate for the study area is a typical marine climate characteristic of the Puget Sound region. For this study two rain gage monitoring stations were established, one behind Freeland Plaza and the other on Fish Road approximately one mile south of S.R. 525. Precipitation was monitored with tipping bucket rain gages. Table 2-1 summarizes the recorded rainfall for 2003.

Table 2-1: Freeland Monthly Precipitation Data

	Precipitation *(inches)*	
	Freeland Plaza	**Fish Road**
January	4.24	2.76
February	1.00	1.19
March	2.77	3.10
April	2.21	2.19
May	1.37	0.50
June	0.67	0.52
July	0.03	0.04
August	0.23	0.37
September	0.97	1.33
October	0.26*	3.32
November	4.37	4.23
December	3.40	4.08
Total	21.52	23.63

* Anomaly may be due to equipment malfunction.

The rainy season normally begins in October and extends typically to June. The mean annual temperature is 49.8 degrees Fahrenheit.

The largest single day precipitation event recorded was 1.77 inches occurring on November 18, 2003. This is slightly greater than the anticipated 10-year, 24-hour storm event.

2.3 Basin Descriptions

The study area consists of 1,500 acres. The natural topography defines three distinct drainage basins within the study area that discharge to Holmes Harbor. They are denoted within the report simply as the West, Central and East Basins. Within each major basin there are numerous subbasins that are defined by local topography and man-made features, such as, roads, ditches and culverts. These subbasins are generally connected hydraulically through some stormwater infrastructure or natural conveyance system to a common discharge point or points. There are two subbasins that lie within the NMUGA but do not discharge to Holmes Harbor (W-19 and N-18). These subbasins have been evaluated separately (Figure 2-5).

The West Basin includes 19 subbasins (W-1 to W-19) and extends from the south boundary of the Holmes Harbor Golf & Yacht Club to Woodard Road on the east and encompasses approximately 541 acres (see Figure 2-2 and Figure 2-5A). This basin has a proposed zoning designation of medium and low density with the exception of the area along the S.R. 525 highway corridor, which is designated business general, industrial and mixed use. This basin presently includes a small number of commercial enterprises along with the Nichols Brothers Boatyard. It is drained by two major outfalls, a 24-inch outfall at Ships Haven Drive and a 24-inch outfall vault near the intersection of Cameron Road and Shoreview Drive.

The Central Basin is approximately 719 acres. It was further divided into 18 subbasins located north of S.R. 525 (N-1 to N-18) and includes the area roughly between Woodard Road and Newman Road (see Figure 2-3 and Figure 2-5B). The area south of S.R. 525 is comprised of 12 subbasins (S-1 to S-12) totaling more than 440 acres. Zoning is low density and mixed use within the NMUGA and rural and rural residential for those basins outside of the proposed NMUGA. The Central Basin encompasses the major commercial area for the Freeland community including the S.R. 525 corridor, as well as, commercial properties served by the Main Street corridor. This basin is drained by the newly constructed 36-inch Freeland Park Outfall, which discharges to Holmes Harbor.

The East Basin is approximately 227 acres and includes 6 subbasins (E-1 to E-4) and the Plat of Whispering Firs (WF-1 and WF-2). These lie to the north and south of East Harbor Drive (see Figure 2-4). This area is zoned for low density and medium density housing. Basins E-1 and WF-1 (16.35 acres) and E-2 and WF-2 (162.8 acres) drain to separate 12-inch culverts under East Harbor Drive that discharge across private property and over high bluff to Holmes Harbor. There are no outfalls serving the East Basins.

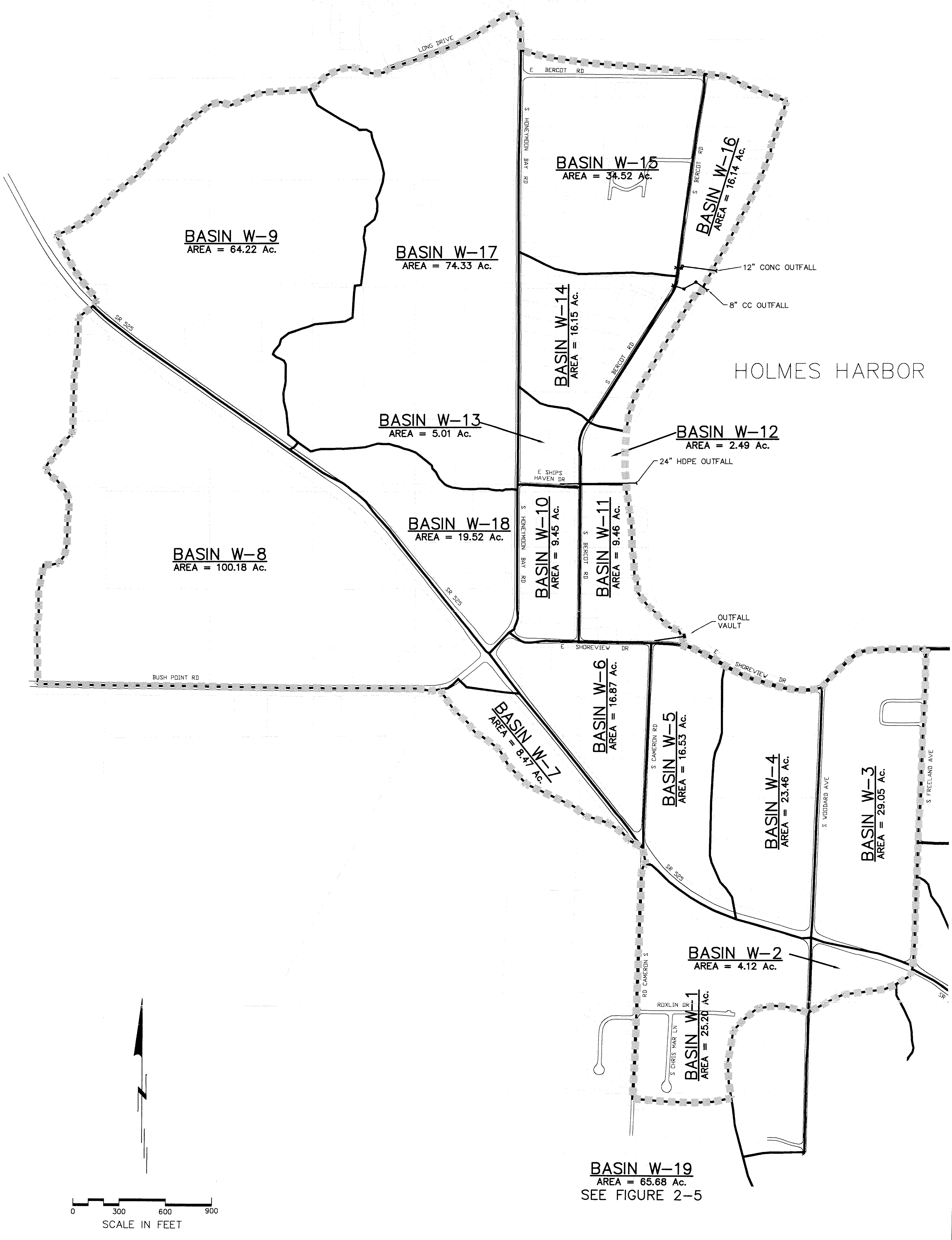


FIGURE 2-2
WEST BASIN
1" = 600'

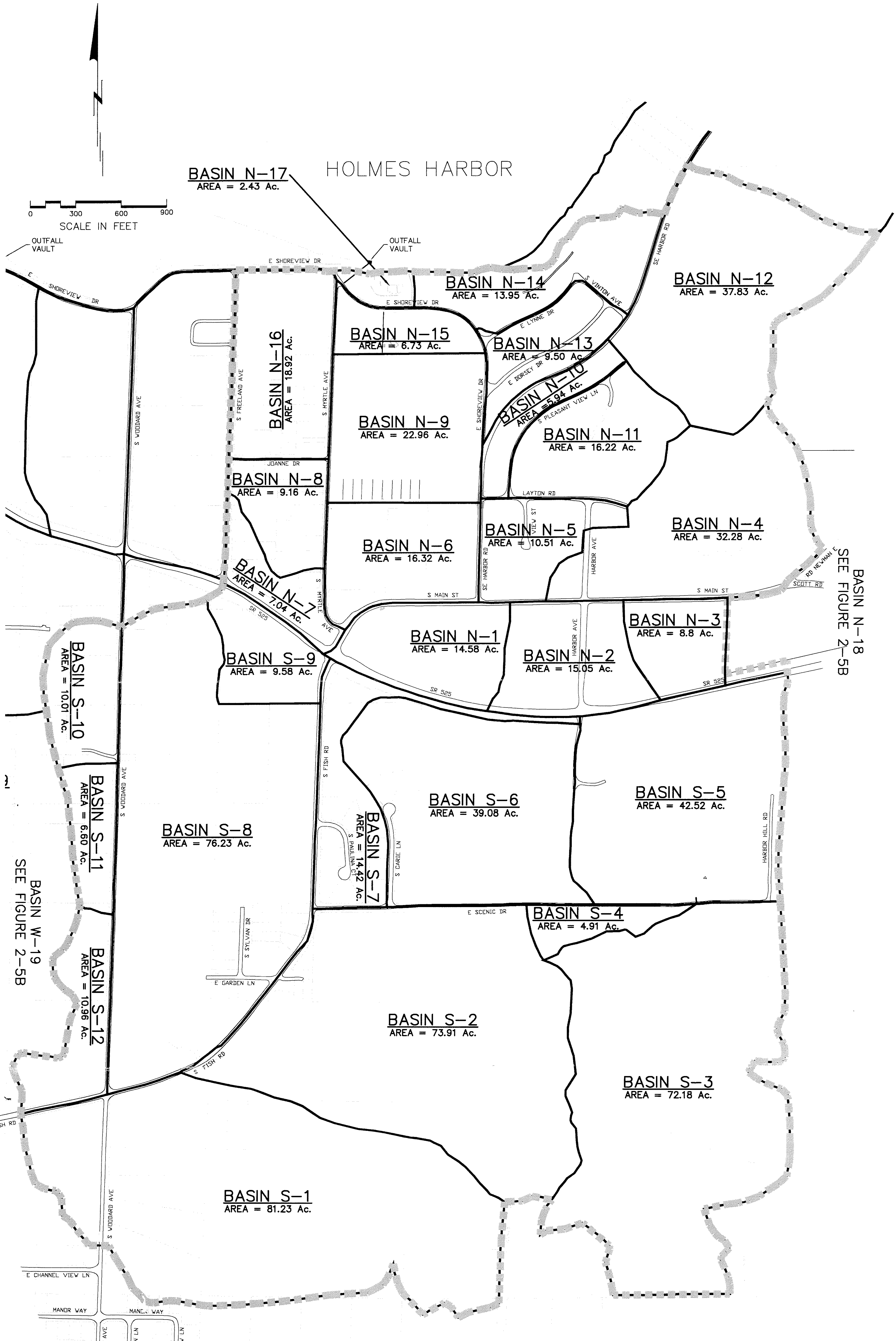


FIGURE 2-3
CENTRAL BASIN
1" = 600'

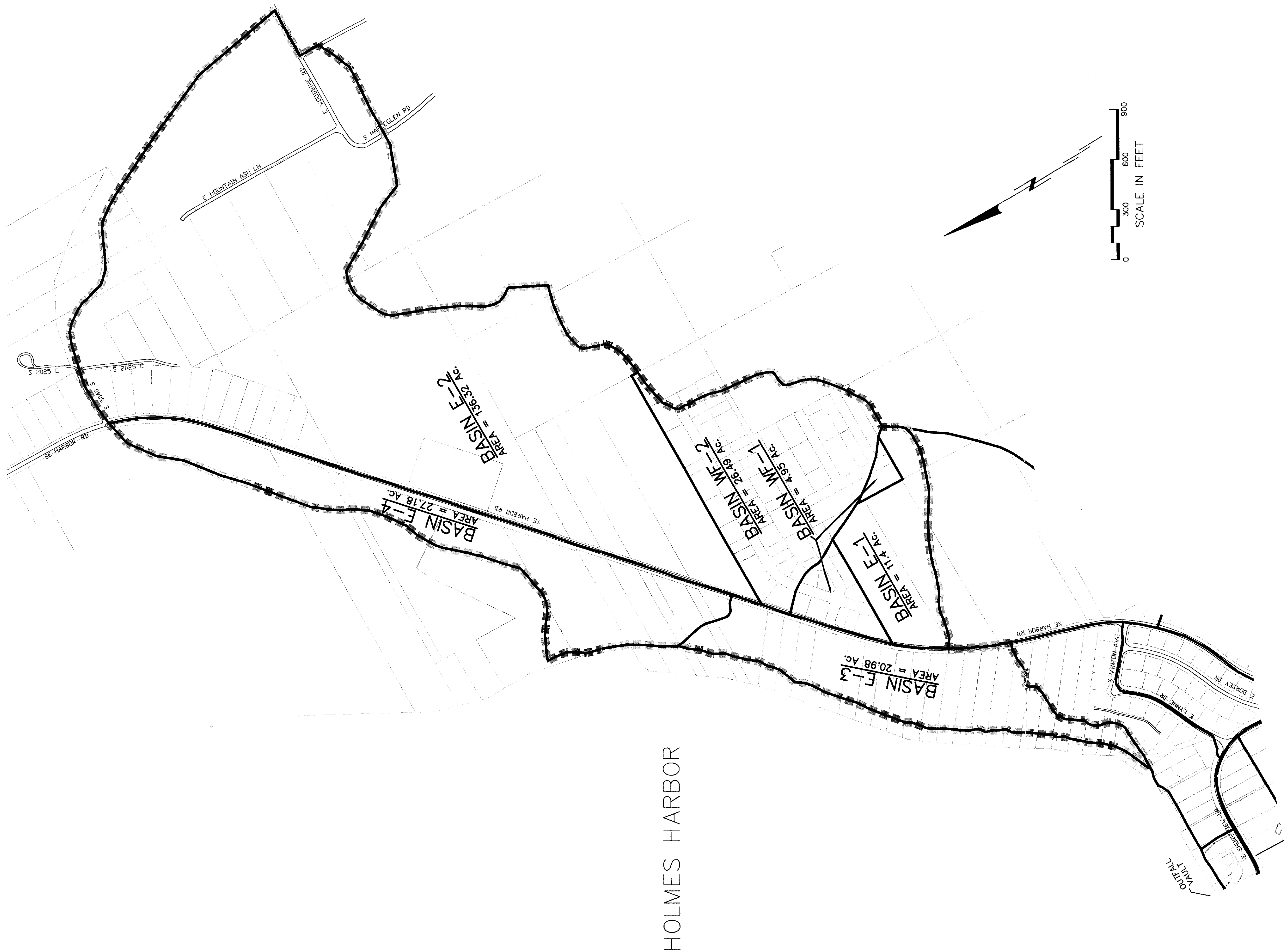
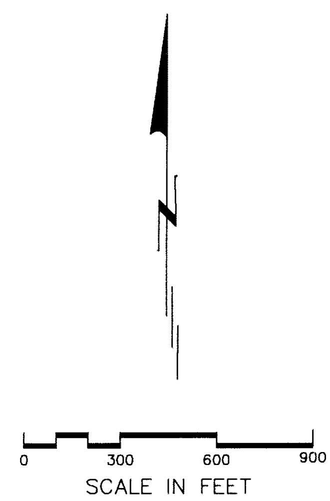


FIGURE 2–4
EAST BASIN
1" = 600'



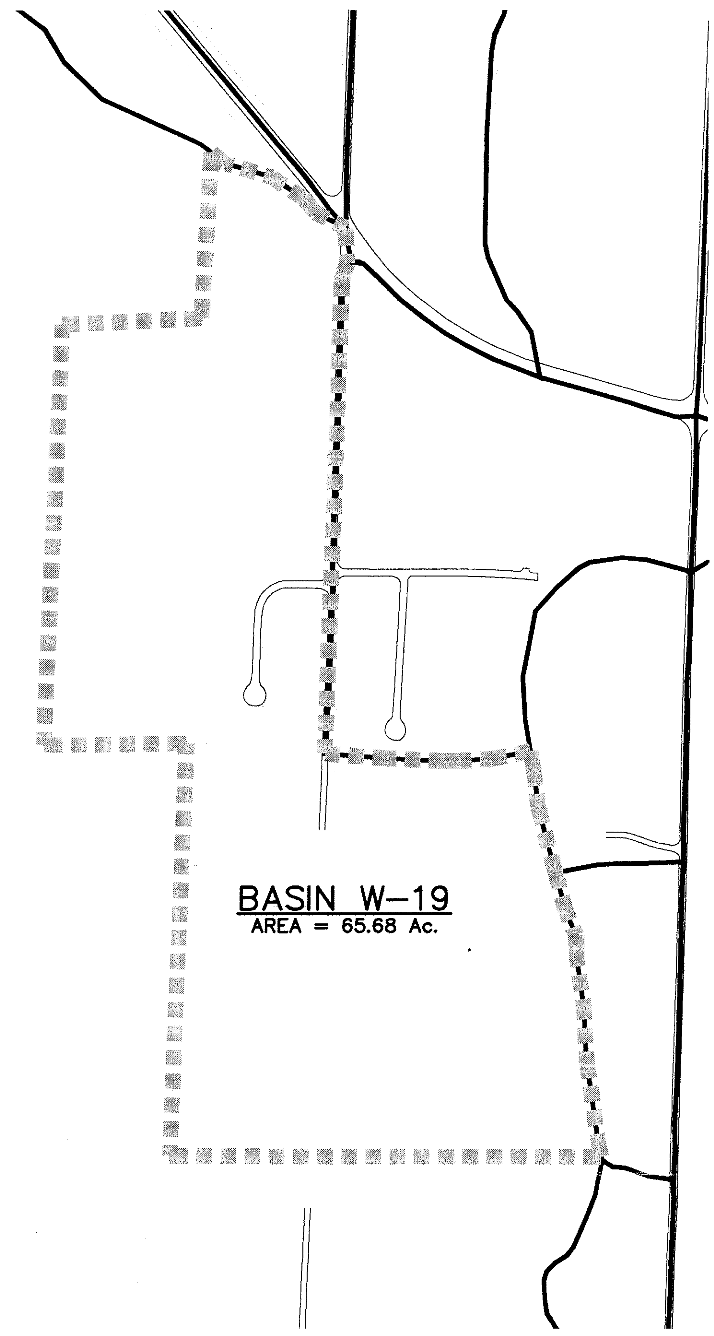


FIGURE 2-5A
W-19 OFFSITE BASIN
1" = 600'

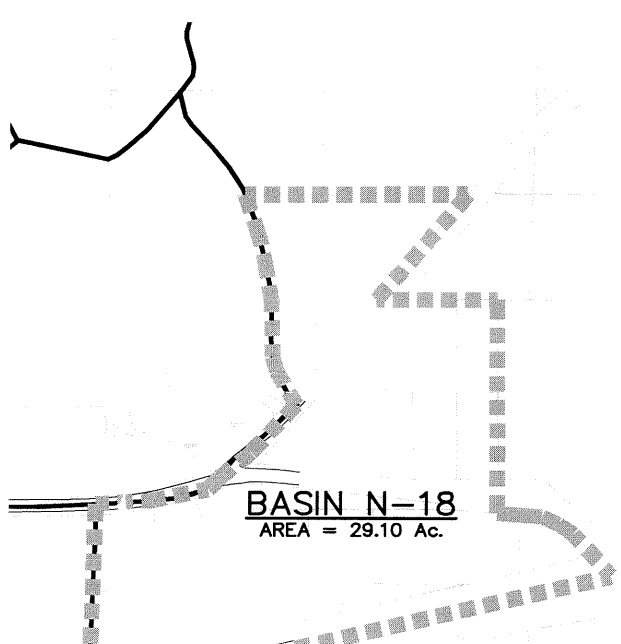


FIGURE 2-5B
N-18 OFFSITE BASIN
1" = 600'

FIGURE 2-5
OFFSITE BASINS
1" = 600'

2.4 Soils and Vegetation

Soils were evaluated based on the Soil Conservation Service Soil Survey for Island County (August 1958). Map Sheet 11 (see Appendix – Volume 2) encompasses the entire study area. The Soil Survey classifies soils in four hydrologic soil groups (HSG). The following description of soil groups is excerpted from The U.S. Department of Agriculture, Natural Resources Conservation Service, 2002. National Soil Survey Handbook:

> *The soils in the United States are placed into four groups, A, B, C, and D, and three dual classes, A/D, B/D, and C/D. In the definitions of the classes, infiltration rate is the rate at which water enters the soil at the surface and is controlled by the surface conditions. Transmission rate is the rate at which water moves in the soil and is controlled by soil properties. Definitions of the classes are as follows:*
>
> *A. (Low runoff potential). The soils have a high infiltration rate even when thoroughly wetted. They chiefly consist of deep, well drained to excessively drained sands or gravels. They have a high rate of water transmission.*
>
> *B. The soils have a moderate infiltration rate when thoroughly wetted. They chiefly are moderately deep to deep, moderately well drained to well drained soils that have moderately fine to moderately coarse textures. They have a moderate rate of water transmission.*
>
> *C. The soils have a slow infiltration rate when thoroughly wetted. They chiefly have a layer that impedes downward movement of water or have moderately fine to fine texture. They have a slow rate of water transmission.*
>
> *D. (High runoff potential). The soils have a very slow infiltration rate when thoroughly wetted. They chiefly consist of clay soils that have a high swelling potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. They have a very slow rate of water transmission.*
>
> *Dual hydrologic groups, A/D, B/D, and C/D, are given for certain wet soils that can be adequately drained. The first letter applies to the drained condition, the second to the undrained. Only soils that are rated D in their natural condition are assigned to dual classes. Soils may be assigned to dual groups if drainage is feasible and practical.*

The Freeland area soils data were digitized from Map Sheet 11 of the Island County Soil Survey and a basin soil map was created in order to calculate the extent of each soil type within each subbasin. Figure 2-6 depicts the soils map for the Freeland basin. The predominant soil types in the West Basin are Whidbey gravelly sandy loam, an HSG C soil and Keystone loamy sand an HSG A soil. In the Central Basin, Keystone loamy sand is the predominant soil. In the East Basin a mix of Keystone and Whidbey gravelly sandy loam (HSG A and HSG C soils) are found. HSG A soils are highly infiltrative soils and may provide excellent opportunities for stormwater infiltration. However, the glacial deposits that characterize the soils in this area are often discontinuous and unpredictable. Designs for infiltration will require field investigation.

Because soil allows the absorption of surface runoff into the soil media, it is considered a "pervious" surface. The vegetative ground cover on the soil surface influences its ability to absorb runoff. The general vegetation or ground cover classifications used for pervious areas in the hydrologic analysis are forested, pasture and gravel. These ground cover types were estimated from aerial photography (see Figure 2-6a).

Impervious surfaces are those surfaces that prohibit the movement of water (surface runoff) from the land surface into the underlying soil. Buildings and paved surfaces (i.e., asphalt and concrete) are examples of impervious ground covers. Impervious surfaces typically drain to a storm drain system and are referred to as directly connected impervious area or effective impervious area. Impervious surfaces that do not drain directly to a storm drain system are considered disconnected impervious area (DIA). For example, a single-family residence may have a roof and downspout system that discharges to a splash block and sheet flows over the lawn surface. This runoff must flow overland, some distance, before it enters a storm drain system. This is an example of disconnected impervious area (DIA). Connected and disconnected impervious area was calculated for each subbasin based on roads, building and driveway footprints evident from aerial photography.

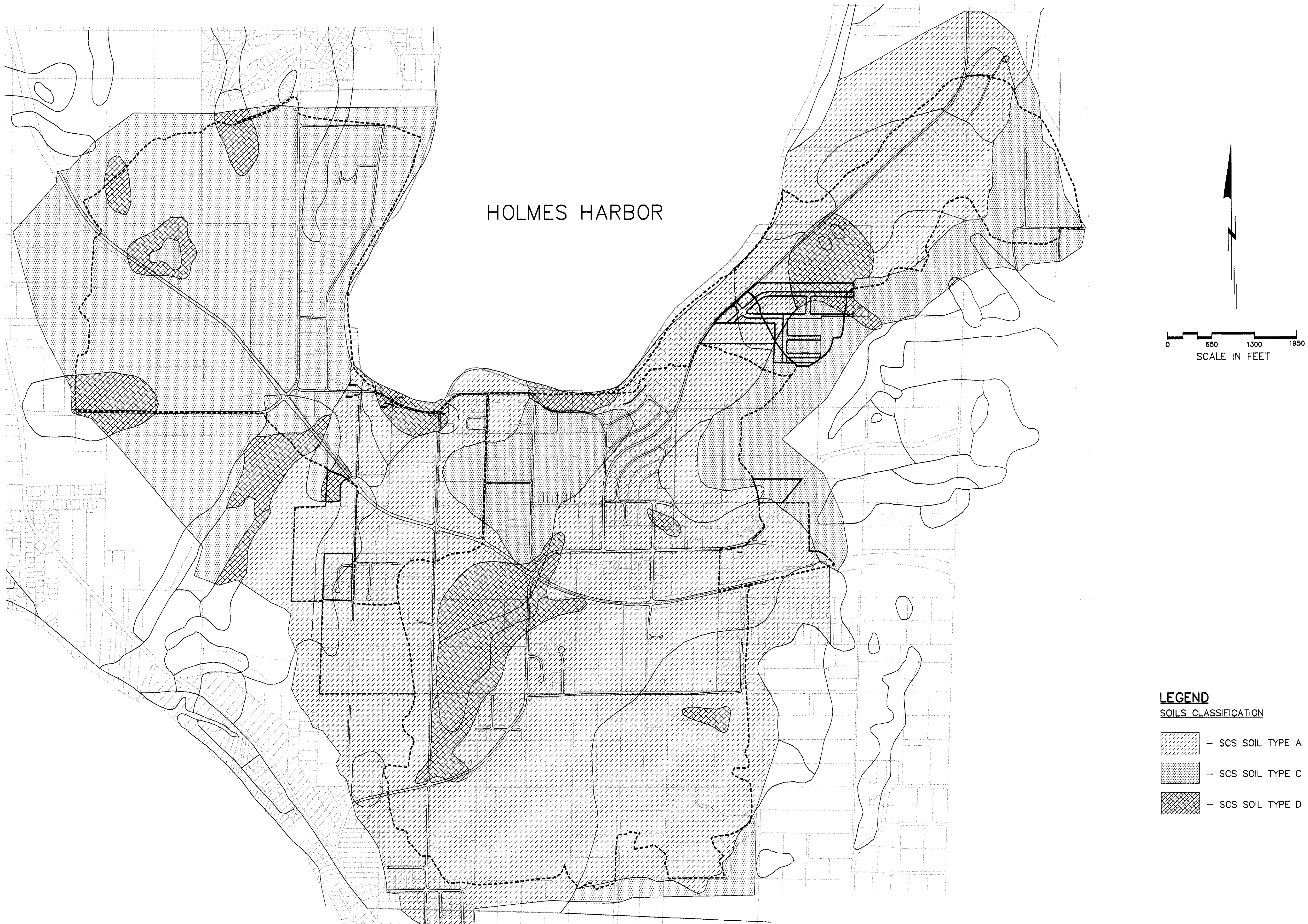


FIGURE 2–6
FREELAND DRAINAGE BASIN SOILS MAP
1" = 1300'

FIGURE 2-6A
FREELAND BASIN AERIAL PHOTOGRAPH
SCALE 1"=1500'

2.5 Land Use

The basin area was modeled for both existing and future conditions. Mapping was developed from aerial topographic survey data. The actual pervious and impervious areas for each basin were calculated based on the aerial mapping and are summarized in Table 2-2 for existing conditions. The proposed land use designations for the Freeland NMUGA (Figure 2-7) were used to calculate development densities for a full build out scenario for future conditions in each basin. For example, low density residential will allow development of single family or duplex housing at a density of no more than three dwelling units (DU) per acre. For those areas zoned low density residential the highest density (3 DU/acre) was selected. Table 2-4 was used to calculate the percentage of impervious area associated with the various development densities. The pervious and impervious area totals for future conditions are summarized in Table 2-3.

FREELAND - EXISTING CONDITIONS AVERAGE CN COMPUTATIONS

	SOILS A			SOILS C			SOILS D			Disconn.	Pervious	Pervious	Connected	Total
BASIN DESIGNATION	Wooded	Grass	Gravel	Wooded	Grass	Gravel	Wooded	Grass	Gravel	Imperv.	Area	CN	Imperv.	Area
Basin S-1	68.66	10.47	0.35	0.32						0.25	80.05	33.47	1.18	81.23
Basin S-2	52.67	17.67	1.39							1.08	72.81	35.52	1.10	73.91
Basin S-3	52.44	13.84	0.72				3.03	0.31	0.05	1.70	72.09	37.56	0.09	72.18
Basin S-4	3.49	0.90	0.13							0.13	4.65	36.43	0.26	4.91
Basin S-5	24.01	14.48	2.01							0.92	41.42	38.05	1.10	42.52
Basin S-6	19.83	13.62	0.83				1.88	0.82		0.66	37.64	40.05	1.44	39.08
Basin S-7	1.16	8.34	0.19				1.27	1.59		0.70	13.25	50.79	1.17	14.42
Basin S-8	7.86	12.27	0.00				19.64	12.54	1.05	0.62	53.98	63.75	22.25	76.23
Basin S-9		0.33	0.32				0.10	3.29	1.57	0.27	5.88	81.23	3.70	9.58
Basin S-10	5.79	3.29	0.34							0.34	9.76	38.19	0.25	10.01
Basin S-11	3.60	2.20	0.30							0.24	6.34	39.01	0.26	6.60
Basin S-12	6.50	2.82	0.07				0.36	0.36		0.26	10.37	39.15	0.59	10.96
Basin N-1	3.07	4.27	0.22				1.46				9.02	43.99	5.56	14.58
Basin N-2	0.59	5.17	1.11								6.87	44.38	8.18	15.05
Basin N-3	6.39	5.72	0.11							0.75	12.97	39.28	0.81	13.78
Basin N-4	8.91	7.99	0.15	4.85			0.25	1.06			23.21	45.75	9.07	32.28
Basin N-5	1.66	3.73	0.24		0.29					0.20	6.12	42.14	4.39	10.51
Basin N-6		3.37			3.98			0.51	0.03		7.89	59.50	8.43	16.32
Basin N-7	0.39	1.08	0.04	0.72	3.07	0.17	0.06	0.37		0.16	6.06	66.31	0.98	7.04
Basin N-8				3.02	4.43	0.48				0.59	8.52	75.80	0.64	9.16
Basin N-9	2.11	1.20		7.16	10.69	0.67				0.61	22.44	68.64	0.52	22.96
Basin N-10	1.15	2.77	0.11							0.88	4.91	48.76	1.03	5.94
Basin N-11	7.35	5.49	0.35	0.10						0.28	13.57	37.62	2.65	16.22
Basin N-12	20.24	2.21	0.10	14.84						0.06	37.45	48.49	0.38	37.83
Basin N-13	1.73	2.90	0.03	0.45	1.74					0.03	6.88	48.67	2.62	9.50
Basin N-14	1.28	6.41	0.47	0.21	0.71	0.05		2.36	0.14	1.73	13.36	57.62	0.59	13.95
Basin N-15				1.36	4.48	0.16				0.33	6.33	75.20	0.40	6.73
Basin N-16	2.10	3.78	0.20	5.66	4.87	0.32		0.09		0.50	17.52	61.78	1.40	18.92
Basin N-17								1.45			1.45	80.00	0.98	2.43
Basin E-1	12.57	0.62	0.10	2.79							16.08	39.48	0.27	16.35
Basin E-2	69.43	11.43	0.84	43.00	7.39	1.00	23.88	0.72	0.18	3.50	161.37	54.33	1.44	162.81
Basin E-3	10.41	7.97	0.73							1.40	20.51	40.79	0.47	20.98
Basin E-4	17.10	7.98	0.01				0.26	0.32	0.02	0.49	26.18	36.48	1.00	27.18
Basin W-1	5.04	18.39								0.24	23.67	38.11	1.53	25.20
Basin W-2	0.76	1.43	0.21							0.02	2.42	40.50	1.70	4.12
Basin W-3	3.19	11.28	0.54	1.63	7.80	0.23				1.03	25.70	54.44	3.35	29.05
Basin W-4	2.52	13.96	0.83				3.11	1.50		0.30	22.22	48.75	1.24	23.46
Basin W-5	0.82	4.63	5.07					0.15		0.02	10.69	56.70	5.84	16.53
Basin W-6	1.21	4.54	0.15	4.06	3.25	0.07	0.74	0.54	0.05	0.25	14.86	60.36	2.01	16.87
Basin W-7		0.25		2.57	2.00		0.39	2.66			7.87	74.51	0.60	8.47
Basin W-8				56.59	16.77	7.20	12.10	1.00		1.82	95.48	75.10	4.70	100.18
Basin W-9				44.08	6.86		10.23	1.98		0.14	63.29	73.66	0.93	64.22
Basin W-10				4.20	3.62	0.39				0.46	8.67	74.98	0.78	9.45
Basin W-11	0.34	0.96	0.08	1.97	4.27	0.34				1.07	9.03	71.69	0.43	9.46
Basin W-12				1.03	0.85	0.03				0.43	2.34	77.72	0.15	2.49
Basin W-13				2.50	1.84	0.17				0.14	4.65	74.20	0.36	5.01
Basin W-14				10.07	3.76	1.06				0.68	15.57	74.78	0.58	16.15
Basin W-15				23.56	7.63	0.46				1.10	32.75	73.58	1.77	34.52
Basin W-16				4.07	8.42	0.72				2.26	15.47	77.68	0.67	16.14
Basin W-17				43.64	19.13	1.15	4.51	1.28	0.00	0.73	70.44	73.68	3.89	74.33
Basin W-18				14.01	3.83	0.24				0.12	18.20	72.82	1.32	19.52
CN VALUES	32.00	39.00	76.00	72.00	74.00	89.00	79.00	80.00	91.00	98.00			98.00	

Table 2-2

	FREELAND - FUTURE CONDITIONS PERVIOUS/IMPERVIOUS AREA CALCULATIONS																													
	SOILS A								SOILS C								SOILS D													
BASIN DESIGNATION	100% Imp.	5.00 Acre	Rural Est.	Low Den.	Med. Den.	High Den.	Mixed Use	90% Imp.	100% Imp.	5.00 Acre	Rural Est.	Low Den.	Med. Den.	High Den.	Mixed Use	90% Imp.	100% Imp.	5.00 Acre	Rural Est.	Low Den.	Med. Den.	High Den.	Mixed Use	90% Imp.	Disconn. Imperv.	Pervious Area	Pervious CN	Connected Imperv.	Total Area	BASIN DESIGNATION
Basin S-1		80.54								0.31								0.38							0.00	75.54	68.17	5.69	81.23	Basin S-1
Basin S-2		73.87																0.04							0.00	68.74	68.01	5.17	73.91	Basin S-2
Basin S-3		68.58								0.20								3.40							0.00	67.13	69.09	5.05	72.18	Basin S-3
Basin S-4		4.91																							0.00	4.57	68.00	0.34	4.91	Basin S-4
Basin S-5		13.54					28.98																		0.00	24.18	68.00	18.34	42.52	Basin S-5
Basin S-6				26.07			10.17													2.84					0.00	23.15	69.78	15.93	39.08	Basin S-6
Basin S-7				10.75			0.35													3.32					0.00	9.43	73.11	4.99	14.42	Basin S-7
Basin S-8		13.84		7.27				5.36									16.24	15.08		14.36				4.08	0.00	42.12	80.49	34.11	76.23	Basin S-8
Basin S-9								1.96																7.62	0.00	0.96	85.50	8.62	9.58	Basin S-9
Basin S-10			10.01																						0.00	8.51	68.00	1.50	10.01	Basin S-10
Basin S-11		0.27	6.33																						0.00	5.63	68.00	0.97	6.60	Basin S-11
Basin S-12		10.13																0.83							0.00	10.19	69.67	0.77	10.96	Basin S-12
Basin N-1								12.42																2.16	0.00	1.46	71.26	13.12	14.58	Basin N-1
Basin N-2								15.05																	0.00	1.51	68.00	13.55	15.05	Basin N-2
Basin N-3								8.80																	0.00	0.88	68.00	7.92	8.80	Basin N-3
Basin N-4				5.65				20.05			1.70	3.14												1.74	0.00	9.43	75.12	22.85	32.28	Basin N-4
Basin N-5						2.50		7.64																0.37	0.00	1.60	68.51	8.91	10.51	Basin N-5
Basin N-6								9.58								4.95								1.79	0.00	1.63	75.87	14.69	16.32	Basin N-6
Basin N-7								1.88								4.36								0.80	0.00	0.70	81.65	6.34	7.04	Basin N-7
Basin N-8																9.16									0.00	0.92	86.00	8.24	9.16	Basin N-8
Basin N-9					1.82			1.63					17.61			1.90									0.00	9.68	84.07	13.28	22.96	Basin N-9
Basin N-10				5.94																					0.00	3.92	68.00	2.02	5.94	Basin N-10
Basin N-11				8.26		4.67		3.19				0.10													0.00	7.33	68.16	8.89	16.22	Basin N-11
Basin N-12				22.99						5.72		9.12													0.00	26.51	75.70	11.32	37.83	Basin N-12
Basin N-13				6.35								3.15													0.00	6.27	73.97	3.23	9.50	Basin N-13
Basin N-14				9.75								1.30								2.90					0.00	9.21	74.25	4.74	13.95	Basin N-14
Basin N-15												6.56								0.17					0.00	4.44	86.10	2.29	6.73	Basin N-15
Basin N-16				6.39	0.81							1.92	9.21			0.46				0.13					0.00	10.43	78.08	8.49	18.92	Basin N-16
Basin N-17	Park Area Use Existing CC and Impervious																								0.00	1.45	80.00	0.98	2.43	Basin N-17
Basin N-18								25.30				3.80													0.00	5.04	80.00	24.06	29.10	Basin N-18
Basin E-1 Rev				9.52						1.22		0.66													0.04	7.85	72.13	3.50	11.40	Basin E-1 Rev
WF-1 PST					3.99								0.96												0.00	2.38	71.49	2.57	4.95	WF-1 PST
Basin E-2 Rev		73.69		2.86						39.73		0.62						1.35		18.07					6.03	120.96	77.00	9.34	136.32	Basin E-2 Rev
WF-2 PST				0.32	6.96					3.16			10.39								5.66				0.11	14.19	82.38	12.18	26.49	WF-2 PST
Basin E-3				20.98																					0.00	13.85	68.00	7.13	20.98	Basin E-3
Basin E-4		20.09		6.30														0.24		0.55					0.00	23.43	68.55	3.75	27.18	Basin E-4
Basin W-1			5.00	8.69			11.51																		0.00	14.59	68.00	10.61	25.20	Basin W-1
Basin W-2								4.12																	0.00	0.41	68.00	3.71	4.12	Basin W-2
Basin W-3				6.51	4.49			6.91					6.07			4.26				0.67	0.14				0.00	10.99	74.49	18.06	29.05	Basin W-3
Basin W-4							18.60																4.86		0.00	9.38	72.56	14.08	23.46	Basin W-4
Basin W-5							15.30																1.23		0.00	6.61	69.64	9.92	16.53	Basin W-5
Basin W-6							7.12					2.61			5.54								1.60		0.00	7.43	79.44	9.44	16.87	Basin W-6
Basin W-7		0.25	0.11							4.35	0.50							2.61	0.65						0.00	7.78	86.78	0.69	8.47	Basin W-7
Basin W-8										13.65								86.53							0.00	93.17	89.45	7.01	100.18	Basin W-8
Basin W-9										41.79		9.72						12.60		0.11					0.00	57.07	86.83	7.15	64.22	Basin W-9
Basin W-10												9.45													0.00	6.24	86.00	3.21	9.45	Basin W-10
Basin W-11				1.69								7.77													0.00	6.24	82.78	3.22	9.46	Basin W-11
Basin W-12												2.49													0.00	1.64	86.00	0.85	2.49	Basin W-12
Basin W-13												5.01													0.00	3.31	86.00	1.70	5.01	Basin W-13
Basin W-14												16.15													0.00	10.66	86.00	5.49	16.15	Basin W-14
Basin W-15												34.52													0.00	22.78	86.00	11.74	34.52	Basin W-15
Basin W-16												16.14													0.00	10.65	86.00	5.49	16.14	Basin W-16
Basin W-17										21.00		45.77						1.41		6.15					0.00	55.11	86.39	19.22	74.33	Basin W-17
Basin W-18										6.07		13.45													0.00	14.52	86.00	5.00	19.52	Basin W-18
Basin W-19			57.78	6.00															1.90						6.71	54.69	80.68	4.28	65.68	Basin W-19
CN VALUES	90.00	68.00	68.00	68.00	68.00	68.00	68.00	68.00	90.00	86.00	86.00	86.00	86.00	86.00	86.00	86.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	98.00			98.00		CN VALUES
% Impervious	100.00%	7.00%	15.00%	34.00%	52.00%	68.00%	60.00%	90.00%	100.00%	7.00%	15.00%	34.00%	52.00%	68.00%	60.00%	90.00%	100.00%	7.00%	15.00%	34.00%	52.00%	68.00%	60.00%	90.00%	0.00			98.00		% Impervious

Table 2-3

Runoff Curve Numbers for Selected Agricultural, Suburban, and Urban Areas

(Sources: TR 55, 1986, and Stormwater Management Manual, 1992. See Section 2.1.1 for explanation)

Cover type and hydrologic condition.	CNs for hydrologic soil group A	B	C	D
Curve Numbers for Pre-Development Conditions				
Pasture, grassland, or range-continuous forage for grazing:				
Fair condition (ground cover 50% to 75% and not heavily grazed).	49	69	79	84
Good condition (ground cover >75% and lightly or only occasionally grazed)	39	61	74	80
Woods:				
Fair (Woods are grazed but not burned, and some forest litter covers the soil).	36	60	73	79
Good (Woods are protected from grazing, and litter and brush adequately cover the soil).	30	55	70	77
Curve Numbers for Post-Development Conditions				
Open space (lawns, parks, golf courses, cemeteries, landscaping, etc.)[1]				
Fair condition (grass cover on 50% - 75% of the area).	77	85	90	92
Good condition (grass cover on >75% of the area)	68	80	86	90
Impervious areas:				
Open water bodies: lakes, wetlands, ponds etc.	100	100	100	100
Paved parking lots, roofs[2], driveways, etc. (excluding right-of-way)	98	98	98	98
Porous Pavers and Permeable Interlocking Concrete (assumed as 85% impervious and 15% lawn)				
Fair lawn condition (weighted average CNs).	95	96	97	97
Good lawn condition (weighted average CNs).	94	95	96	97
Paved	98	98	98	98
Gravel (including right-of-way)	76	85	89	91
Dirt (including right-of-way)	72	82	87	89
Pasture, grassland, or range-continuous forage for grazing:				
Poor condition (ground cover <50% or heavily grazed with no mulch).	68	79	86	89
Fair condition (ground cover 50% to 75% and not heavily grazed).	49	69	79	84
Good condition (ground cover >75% and lightly or only occasionally grazed)	39	61	74	80
Woods:				
Poor (Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning).	45	66	77	83
Fair (Woods are grazed but not burned, and some forest litter covers the soil).	36	60	73	79
Good (Woods are protected from grazing, and litter and brush adequately cover the soil).	30	55	70	77
Single family residential[3]: Dwelling Unit/Gross Acre — Should only be used for subdivisions > 50 acres	Average Percent impervious area[3,4]			
1.0 DU/GA	15	Separate curve number shall be selected for pervious & impervious portions of the site or basin		
1.5 DU/GA	20			
2.0 DU/GA	25			
2.5 DU/GA	30			
3.0 DU/GA	34			
3.5 DU/GA	38			
4.0 DU/GA	42			
4.5 DU/GA	46			
5.0 DU/GA	48			
5.5 DU/GA	50			
6.0 DU/GA	52			
6.5 DU/GA	54			
7.0 DU/GA	56			
7.5 DU/GA	58			
PUD's, condos, apartments, commercial businesses, industrial areas & & subdivisions < 50 acres — %impervious must be computed	Separate curve numbers shall be selected for pervious and impervious portions of the site			
For a more detailed and complete description of land use curve numbers refer to chapter two (2) of the Soil Conservation Service's Technical Release No. 55 , (210-VI-TR-55, Second Ed., June 1986).				

[1] Composite CN's may be computed for other combinations of open space cover type.

[2] Where roof runoff and driveway runoff are infiltrated or dispersed according to the requirements in Chapter 2, the average percent impervious area may be adjusted in accordance with the procedure described under "Flow Credit for Roof Downspout Infiltration" and "Flow Credit for Roof Downspout Dispersion" in Chapter 2.

[3] Assumes roof and driveway runoff is directed into street/storm system.

[4] All the remaining pervious area (lawn) are considered to be in good condition for these curve numbers.

Freeland Sub-Area
PROPOSED
Future Land Use

Legend

- NMUGA Boundary
- JPA Boundary

PROPOSED Zoning

- Business General
- Business Office
- Freeland Village
- Industrial
- Low Density
- Medium Density
- High Density
- Mixed Use
- Rural Estate
- Reserve
- Golf Course
- Recreation
- Non-NMUGA Parcels

1 inch equals 2,376 feet

0 1,750 3,500 Feet

0 0.5 1 Miles

Map Prepared By:

Island County Planning
& Community Development
May 27, 2004

The following map is intended to be used as a GUIDE showing the PROPOSED Zoning for the Freeland Sub-Area. All questions should be directed to the Island County Department of Planning & Community Development at (360) 679-7339.

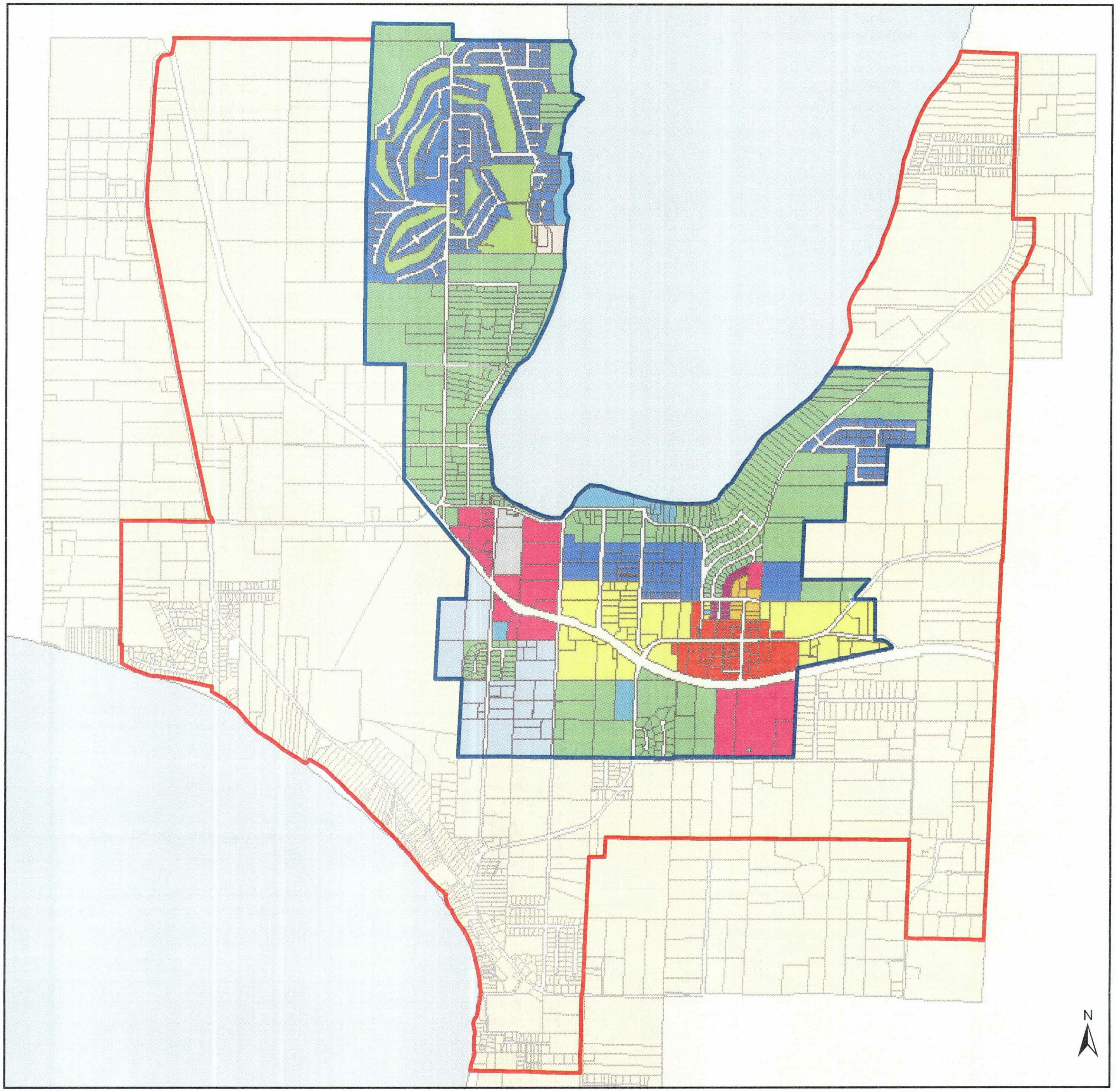


Figure 2-7

2.6 Critical Areas

2.6.1 Overview

Figure 2-8 is a portion of the Island County Critical Areas, Wetlands and Streams Map for the Freeland area. The definition of critical areas encompasses fish and wildlife habitat areas, conservation areas, flood hazard areas, geologically hazardous areas and wetlands and their buffers. In this study, wetlands are the primary critical area of interest. The wetland mapping is based on the National Wetlands Inventory Maps as modified by Island County. It should be noted that only major wetlands in the Freeland area are shown, and the mapped boundaries have not been field verified.

There are five wetlands identified in Figure 2-8 as wetlands of interest within the Freeland Basin. Four of these five were evaluated qualitatively by Adolfson and Associates (see Appendix – Volume 2) to assess wetland functions and categories.

Wetland #1 is the largest of these wetlands. The headwaters and a significant area of this wetland lies south of the proposed NMUGA boundary. Zoning south of the NMUGA boundary is rural. The portion of the wetland lying within the NMUGA is zoned low density. Hydrologic modeling indicates that the moderate increase in runoff quantity will not result in significant changes to the water surface elevation in the wetland for the 2 and 10-year storm events. For this reason, this wetland was not included in the qualitative analysis completed by Adolfson and Associates.

Wetland #2 and #3 straddle S.R. 525 and are connected to each other via a 24-inch PVC culvert under the highway. Wetland #3 outlets to a 24-inch concrete culvert under Main Street that discharges to the Freeland Plaza 30-inch storm drain system and ultimately to the Freeland Park outfall. Wetland #2 is approximately 1.8 acres and receives drainage from 400 acres to the south, east and north. Wetland #3 (approximately 0.75 acres) lies in series with Wetland #2 and receives drainage from an additional 21.5 acres from basins to the east and west (N-1 and N-7). The water surface elevation in both wetlands is currently controlled by a down stream flow splitter device located in a 96-inch catch basin behind Freeland Plaza. The static water surface elevation is approximately 54.0 feet. These wetlands have historically provided detention storage and flow attenuation for over 440 acres during storm events.

Wetland #4 is an estuarine wetland that drains approximately 50 acres in three upstream basins in the West Basin (W-1, W-2 and W-4). Of the four wetlands evaluated by Adolfson, this was the highest quality wetland. It lies adjacent to the Shoreview-Woodard Road intersection and outlets directly to Holmes Harbor via an 18-inch CMP storm drain. A hinged flap gate (tide gate) is installed at the discharge end of the pipe. This area of Shoreview Road floods periodically during large winter storm events. The lowest elevation is a sag curve on Woodard Road at 12.5 feet (tidal datum), which is below the high tide level. Because wetland discharge must overcome the hydraulic head imposed during high tides, hydrograph evaluation has revealed that if peak runoff coincided with a high tide, runoff would overtop Woodard Road during both the 25 and 100-year storm events for future conditions.

The Department of Fish and Wildlife has expressed an interest in having the existing outlet pipe and tide gate replaced with an open channel culvert or larger fish passable tide gate. Because of the potential for flooding, detailed hydraulic, hydrologic and topographic analyses of this wetland should be included among the other studies necessary to fully evaluate any proposed changes to the wetland and the outlet.

Proposed zoning in the upstream contributing basins is mixed use transitional, allowing Planned Rural Development (PRD) type development. Runoff water quality treatment will be required for development projects that discharge to this wetland. Projects will have to be evaluated on a case-by-case basis to determine if on-site detention is required per Island County Code.

Wetland #5 is a closed depression of approximately 26.0 acres that lies east of the proposed NMUGA boundary and is bounded by Newman Road to the north, Scott Road to the south and Doublebluff Road to the east. Because it is both a wetland and closed depression, stormwater discharge is regulated under Island County's critical area ordinance (ICC 17.02.150 M.1.a.i) and *Island County Stormwater Design Manual* 3.1.3 (closed depression analysis). At the time of the field visit (December 21, 2004), the wetland water surface was not visible from the buffer areas. In years past the wetland has overtopped Doublebluff Road during large rain events. A culvert was constructed under Doublebluff Road by Island County to provide an outlet to a field on the east side of Doublebluff that provides overflow storage.

There are approximately 14 tax parcels (29.1 acres) that lie within the proposed NMUGA boundary (proposed zoning - Business General) that drain to Wetland #5. Approximately five of these parcels have been fully developed. Because Freeland was designated a critical drainage basin at the time of their development, these parcels were required to construct on-site stormwater retention systems. In some cases, the overflow from on-site systems is allowed to discharge to Wetland #5, where gravity flow is possible. For the remaining undeveloped parcels and those that could be developed at greater densities, runoff quantity remains an issue. None of the stormwater infrastructure improvements in the Central Basin have altered or affected this off-site drainage basin. The critical drainage basin designation should remain until a closed depression analysis for this basin is completed. This will not only entail a basin delineation and hydrologic analysis, but an estimation of infiltration rates within the 26-acre wetland will be necessary. Additionally, runoff water quality treatment should be required before discharge to the wetland.

A possible alternative to wetland discharge is to discharge to the Main Street 18-inch trunk drain. The end of the trunk drain lies approximately 1,200 feet west of the Newman-Scott Road intersection. To utilize this system, a stormwater lift station and force main would be required. Because runoff water quality treatment would still be necessary, it is probably not a cost effective or practical alternative for these properties to tie into the Main Street trunk drain. Additionally, this would alter the natural drainage patterns for this basin.

The Freeland Plaza storm drain system discharges a base flow through a flow splitter device to unnamed stream #06-0010. A stream assessment was completed by Herrera Environmental Consultants in a report for Island County Public Works titled *Existing Habitat Conditions – Freeland Water Quality Improvement Project, September 2003*. This report assessed unnamed stream #06-0010 as having poor habitat conditions for salmonids; a majority of the stream reach is impassable due to the presence of culverts. Additionally, the minimal fish rearing habitat was assessed as poor to moderate quality. The goal of the Phase 2 of the Freeland Park Outfall Project is to enhance a portion of the stream reach north of Freeland Plaza.

2.6.2 Wetland Modeling Results

Wetlands #2 and #3 were modeled as part of the Central Basin layout model utilizing the hydrologic software program StormShed. The wetlands were modeled as detention ponds utilizing the level pool routing function. The outlet culverts were modeled as control devices with the tail water elevation controlled by the downstream flow splitter, currently set at approximately 54.0 feet mean sea level (MSL). Stage-storage tables for each pond were developed from the photogrammetric aerial contours. The 2- and 100-year, 24-hour storm events for both existing and future conditions were routed through the model to determine estimated peak water surface elevations during these events. The peak runoff values shown are the peak inflows to each wetland. Table 2-5 summarizes the model results.

Table 2-5: Water Surface Modeling Summary for Existing and Future Conditions

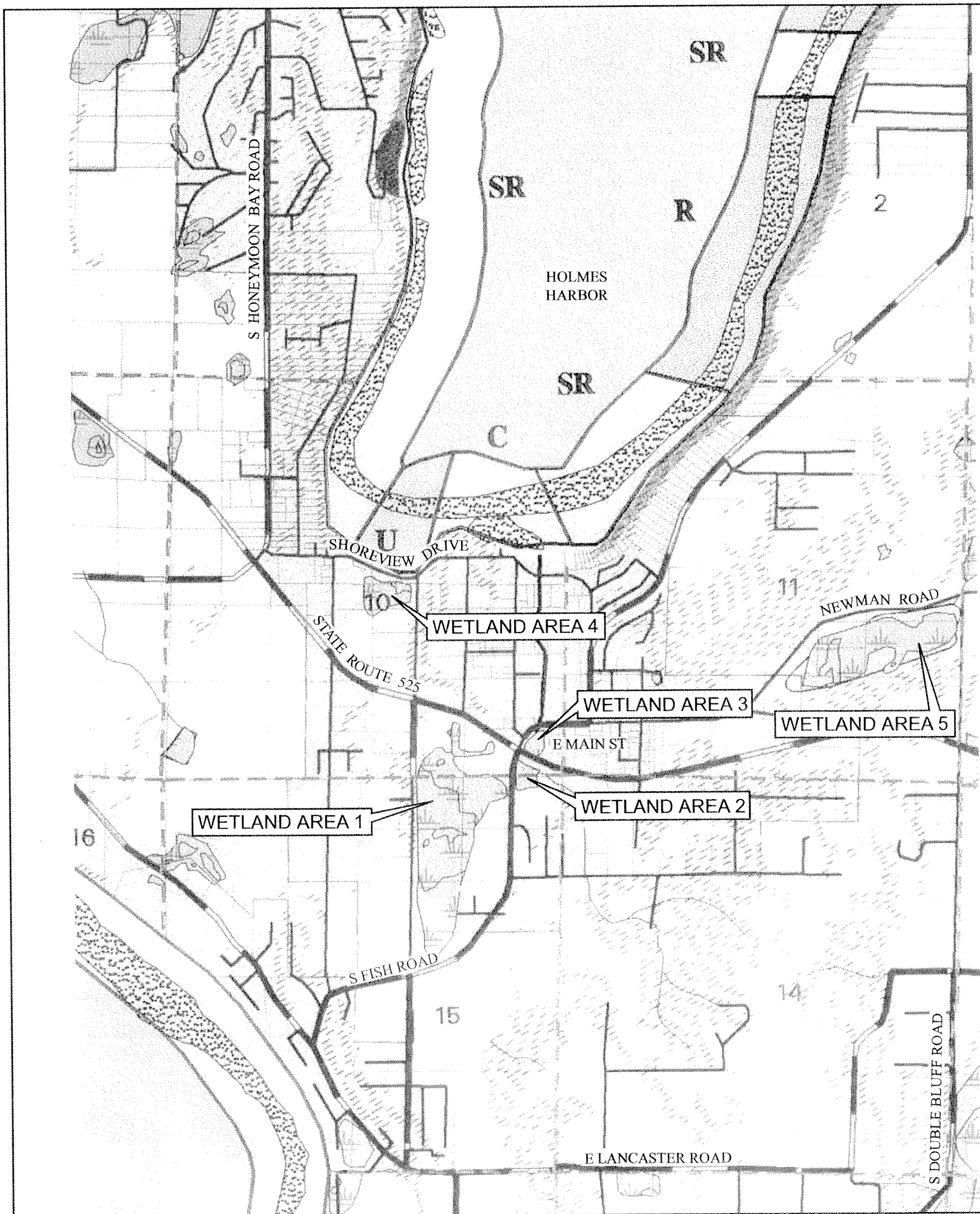
	Water Surface Elevation (ft)/Peak Runoff (cfs)				
	Static	2-yr Existing	2-yr Future	100-yr Existing	100-yr Future
Wetland #2	54.0	54.6/3.0	55.1/11.8	54.8/8.9	56.2/34.1
Wetland #3	54.0	54.6/1.6	55.1/6.3	55.1/7.0	56.8/23.3

The 2-year event was selected to provide an estimate of water surface elevation changes during storm events that should encompass approximately 95% of all annual precipitation. For the 2-year storm event the existing conditions model peak runoff values were within 10% of measured values at the monitoring station located immediately downstream of Wetland #3 (behind Freeland Plaza). There is confidence, therefore, that the wetland storage and water surface elevation (WSE) changes may be reasonable approximations for this storm event. It should be noted that WSE differs from wetland hydroperiod in that the hydroperiod relates to seasonal changes in water surface elevation not simply storm related transients. To determine an accurate hydroperiod, the wetlands would have to be delineated and a water surface monitoring plan utilizing a staff gage would have to be implemented.

The 100-year event was selected to evaluate potential flooding for existing and future conditions. During model calibrations the "existing conditions" model tended to over estimate peak runoff for higher storm events. Therefore, the water surface elevations should be conservative for the 100-year storm event. The predicted water surface elevations for both wetlands are well below roadside shoulder elevations and, therefore no flooding is anticipated even during extreme events.

2.6.3 Wetland Water Quality and Protection

Island County Code 17.02.150 M 1.a.(i.) (1) requires that all surface water directed into wetlands shall be treated by a vegetated detention pond (wet pond) or grass lined swale. Future development and redevelopment projects that discharge to wetlands will require project specific water quality treatment incorporated in their designs. These treatment systems can include vegetative filter strips, bio-filtration swales, bio-retention areas and infiltration among others. Additionally, it was noted that during the wetland field visit December 21, 2004, that highly turbid road runoff from S.R. 525 was entering Wetland #3. It is recommended that water quality treatment be constructed east and west of the Main Street - S.R. 525 intersection to treat runoff from S.R. 525 before it enters both Wetlands #2 and #3.



ADOLFSON

File name: Fig1_Wetlands.ai
Created/last edited by: JAB
Date last updated: 1/5/05

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NOT TO SCALE

Map data are the property of the sources listed below.
Inaccuracies may exist, and Adolfson Associates, Inc. implies no warranties or guarantees regarding any aspect of data depiction.
SOURCE: Island County GIS, 2001.

Figure 2-8

WETLAND AREA LOCATIONS

FREELAND BASIN

ISLAND COUNTY, WASHINGTON

SECTION 3.0 - EXISTING POLICY AND REGULATORY FRAMEWORK

3.1 Overview

This section includes an over view of the existing state and county regulations and ordinances relevant to stormwater management in the Freeland Basin.

3.2 Relevant State Regulations and Programs

The Revised Code of Washington established the Puget Sound Action Team (PSAT) through RCW 90.71 "Puget Sound Water Quality Protection." The PSAT has been given the authority to establish biennial work plans that delineate state and local actions necessary to protect and restore the biological health of the Puget Sound. Element SW-2 gives the Department of Ecology (DOE) the authority to develop and maintain a single stormwater technical manual for the region and oversee the National Pollutant Discharge Elimination System (NPDES) for municipalities, industries and construction sites. Element SW-1.2 requires all cities and counties to develop and implement comprehensive stormwater management programs that include the requirement to adopt the DOE technical manual or an alternative manual that is technically equivalent.

RCW 36.70A "Growth Management" under section RCW 36.70A.70 Comprehensive Plans – Mandatory Elements, stipulates in the land use element that there is to be a review of drainage, flooding, and storm water run-off in the area and nearby jurisdictions. That guidance for corrective action is provided to mitigate or treat runoff entering Puget Sound.

3.3 Relevant County Policies, Ordinances, and Regulations

Pertinent sections of Island County Code (ICC) which were developed to meet the above state requirements relative to storm water runoff and surface water quality are listed below:

ICC 11.02 Clearing and Grading Requirements
ICC 11.03 Stormwater and Surface Water
ICC 17.02 (107, 150M, 250H, 290) Critical Areas

In addition, Island County has adopted by reference the 1992 *Department of Ecology Stormwater Management Manual for the Puget Sound Basin, Technical Manual*, as well as, the *Island County Stormwater Design Manual (1998)* to provide standards and technical guidance to comply with Island County Stormwater Ordinance ICC 11.03.

SECTION 4.0 - DRAINAGE ANALYSIS

4.1 Overview

Hydrologic modeling was performed by the Santa Barbara Urban Hydrograph (SBUH) method utilizing the computer software program StormShed. Existing conditions were modeled within the three major basins (West, Central and East) to verify the causes of existing runoff quantity problems (flooding). Future conditions were modeled to identify potential stormwater problems resulting from increased development and to size future treatment and conveyance systems. The future conditions model used development densities for the proposed NMUGA zoning and assumed maximum build out of all parcels.

The SBUH method is a single event model that utilizes the curve number method. Curve numbers were assigned to each subbasin based on soil type and ground cover utilizing the modified curve number table (Table 2-4) from the *Department of Ecology Western Washington Stormwater Management Manual* (2001). Pervious and impervious areas were calculated for each subbasin using the AutoCad area function. StormShed develops separate hydrographs for pervious and impervious areas. For this reason, the impervious area was further divided into two categories, connected and disconnected impervious area (DIA). DIA areas were included in the pervious basins and a composite curve number was calculated as described in the USDA *Urban Hydrology for Small Watersheds (TR-55 Manual).*

4.2 Model Data Development

Separate hydrologic models were developed for each major basin for both the existing and future conditions utilizing the StormShed layout function. A drainage inventory was completed for each basin based on aerial photography and field inspection (see Figures 4-1 to 4-3). Subbasin areas and curve numbers were calculated for each subbasin based on land use (existing and future). Reaches (i.e., ditches, swales, pipes or culverts) for individual subbasins were identified and dimensioned; storage provided by ponds and wetland areas was estimated based on ground contours and modeled utilizing a level pool routing function. Available survey data for invert elevations of major culverts and catch basins were used in the model where available.

Time of concentration is a hydrologic parameter that greatly affects the peak runoff values from a basin. It is the time it takes for runoff to travel from the hydraulically most distant point of a watershed or basin to the basin outlet. This value influences both the shape and peak of the hydrograph. The time of concentration for each subbasin was calculated based on procedures outlined in the *TR-55 Manual*. The subbasin delineations and reach and node designations for each basin are depicted in Maps 1 through 5 (see Appendix – Volume 2).

Precipitation data for the model runs were taken from isopluvial data found in the *Island County Stormwater Manual* for the 2-, 10-, 25- and 100-year 24-hour storm events (see Appendix – Volume 2). Precipitation data collected at rain gage stations were used in the model calibration, however, there were no recorded storm events that exceeded a "10-year, 24-hour storm event" during the monitoring period. Since the capacity analysis evaluated drainage facilities during the routing of 25- and 100-year, 24-hour storm events the SCS Type 1A storm and isopluvial data were used for these evaluations.

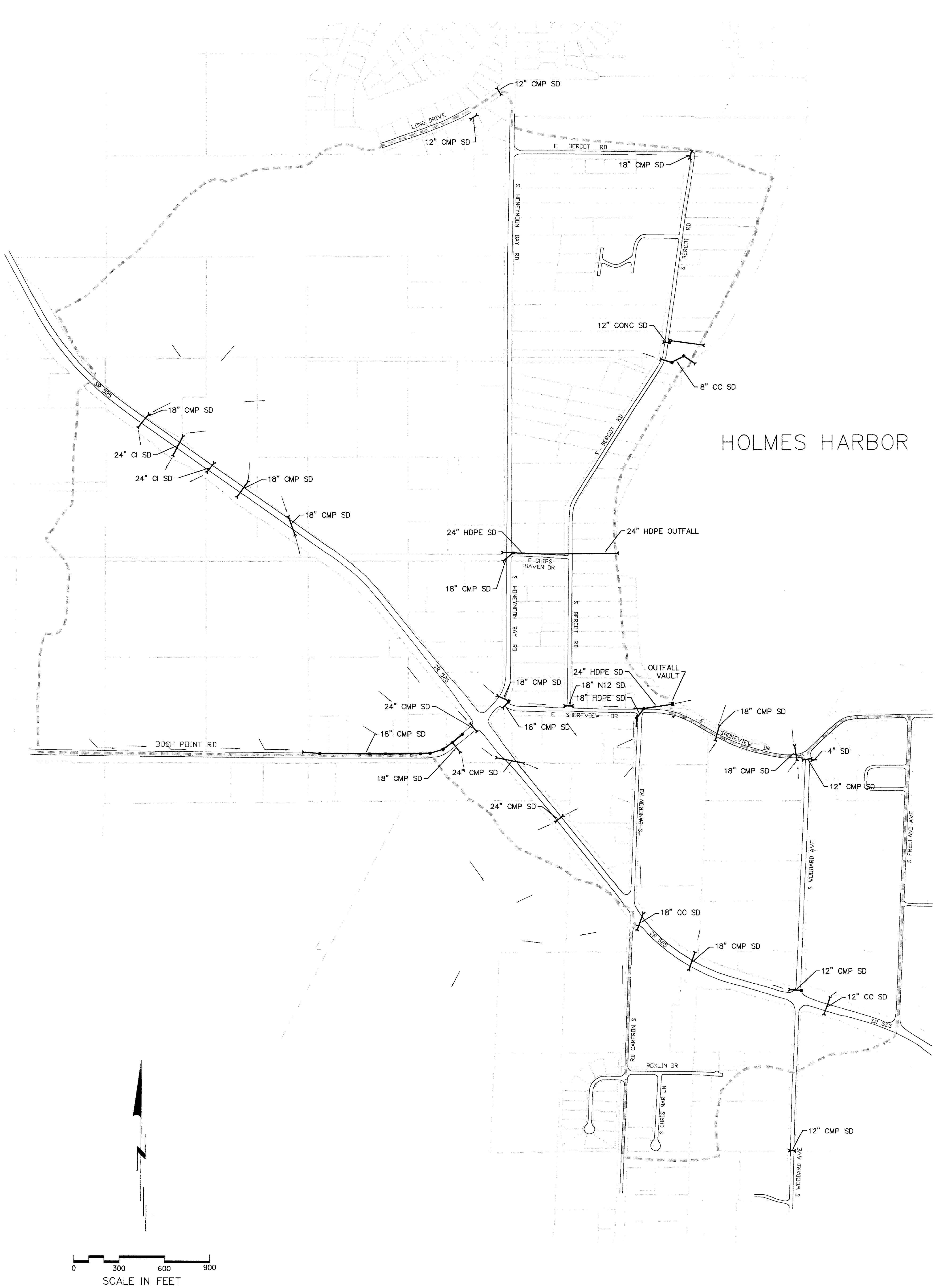


FIGURE 4–1
WEST BASIN INVENTORY
1" = 600'

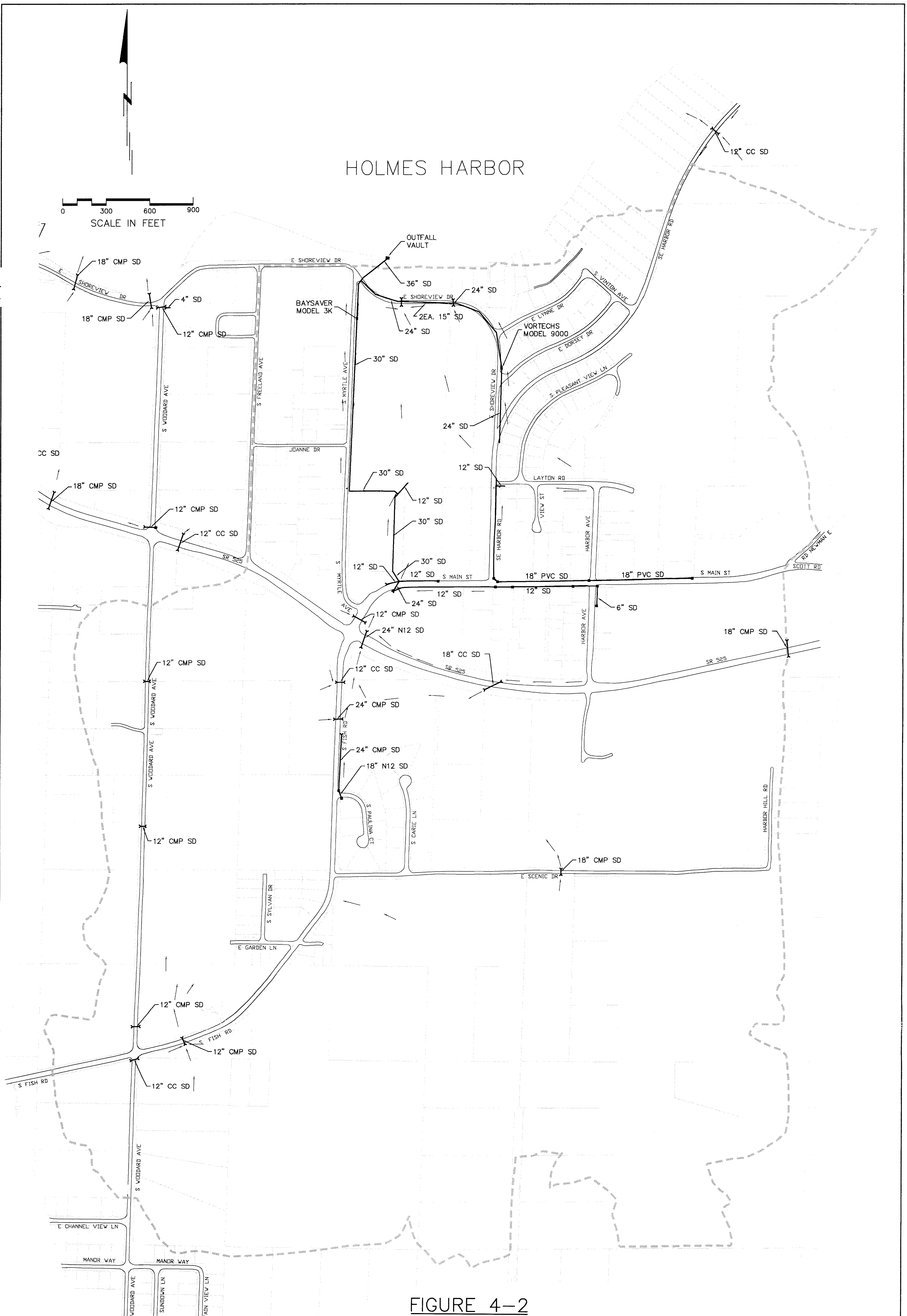


FIGURE 4–2
CENTRAL BASIN INVENTORY
1" = 600'

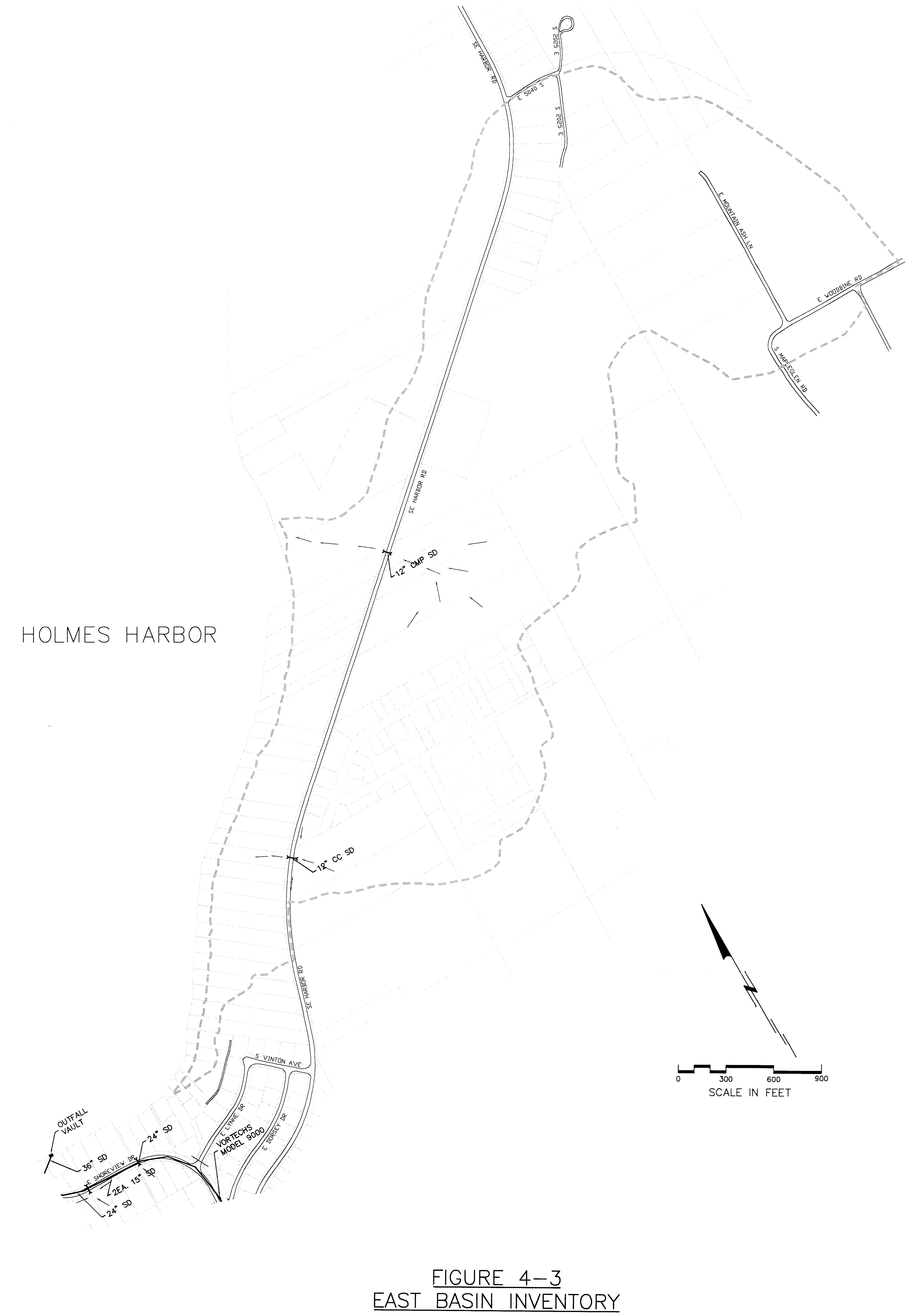


FIGURE 4–3
EAST BASIN INVENTORY

1" = 600'

4.3 Hydrologic Modeling

The 6-month, 2, 10, 25 and 100-year, 24-hour storm events were routed through each model. The StormShed program generated a "layout" report for every run that details, by storm event, the peak flow values for each subbasin, hydraulic analysis of all conveyances and water surface elevations for ponds and structures. Model results for existing conditions were used to verify known flooding or conveyance capacity problems. Results for future conditions were used to identify potential flooding and conveyance problems.

The detailed model results for each basin are found in the Appendix – Volume 2.

4.4 Calibration

Two flow monitoring stations were established in the Central Basin; one behind the Freeland Plaza and the other in the ditch section on the south side of Stewart Road. The monitoring stations consisted of 90-degree V-notch weirs and continuously recording data loggers to record water surface elevation. The elevation of the pressure transducer relative to the V notch was known so that the water surface elevation data could be transformed to an "elevation head" value. Flow at five-minute increments was calculated on an Excel spreadsheet using a flow equation developed for V-notch weirs (see Appendix – Volume 2). As discussed previously, two rain gages were set up to continuously record precipitation.

Precipitation data was reviewed to identify storm events that provided a continuous 24-hour rain event. Isolated storms were selected so that flow monitoring data reflected base flow values at the beginning of the rain event. Three events were selected. The first two events were similar to a 6-month and 2-year storm event, respectively. The 24-hour precipitation amounts were routed through the existing conditions model using a Type 1A hyetograph. A Type 1A storm profile was developed by the Natural Resources Conservation Service and most closely represents storm patterns experienced in Western Washington. The measured flow at the upper monitoring station was within 10% of the peak runoff value predicted by the model for both events, without any parameter calibration.

A third rainfall event (1.77 inches) was selected which was the highest recorded rainfall during the monitoring period and equated to a 10-year, 24-hour storm event. The 24-hour precipitation data was used to develop a custom storm hyetograph matching the recorded event. The custom storm was routed through the model. Measured peak flow was 2.8 cfs, the model predicted a peak flow of 4.7 cfs. The time to peak flow was nearly identical in both the model and in the field data. The length of the hydrograph for both the model and measured flow data spanned 72 hours. The curve numbers in three upstream basins were adjusted down, the time of concentration was increased by approximately 45 minutes in the two adjacent contributing basins (to account for detention) and the peak flow and runoff volumes generated by the model calibrated within 2% of measured values.

While only the existing conditions model for the Central Basin was calibrated, the general agreement between measured and predicted flows provided confidence in the model parameters and methods used in the both the West and East Basins.

The Freeland Park Outfall was designed based on predicted flows for future conditions in the Central Basin utilizing the 100-year, 24-hour isopluvial data and a Type 1A storm. Since there were no recorded storm events that approached the 100-year event, the model could not be calibrated for the extreme storm event. Therefore, isopluvial data was used. Based on the three model calibration runs, peak flows predicted by the model were greater than measured flows utilizing isopluvial data. This approach would, therefore, provide a conservative analysis and design.

Detailed results from the rain gage and flow monitoring stations are found in the Appendix – Volume 2.

4.5 Model Results

4.5.1 Existing Conditions/Current Land Use

The 25- and 100-year storm events were routed through the three basin models to calculate conveyance flow rates and capacities within the existing system for current land use. Wetlands that function as part of the stormwater system were modeled as ponds in order to calculate the water surface elevation during these storm events. Table 4-1 lists calculated peak runoff rates for key conveyances within the three basins. Culverts and storm drain systems were evaluated for capacity based on the 25-year storm event; outfalls are evaluated based on the 100-year storm event.

Table 4-1. Existing Conditions Peak Discharge Rates for Key Conveyances

	Probability Storm Event Model Desig.	0.04 25-Yr Flow (cfs)	0.01 100-Yr Flow (cfs)	Full Flow Conveyance Capacity (cfs)
East Harbor Rd – 12" Culvert*	EX-PN-10A	4.9	5.8	8.3
Pleasant View Lane – 12" Culvert	EX-PN-11A	1.2	1.5	9.6
East Harbor Rd – 12" PVC S.D.*	EX-PN-4B	3.7	4.7	7.1
Main St. – 12" Culvert*	EX-PN-7A	0.4	0.5	3.6
Fish Rd. – 12" Culvert	EX-PS-10A	0.1	0.1	1.9
Shoreview Dr. – 18" Outfall*	EX-PW-4A	2.6	3.2	5.7
Shoreview Dr. – 18" Outfall*	EX-PW-5A	2.6[1]	3.3[1]	1.8
Woodard Rd. – 12" Culvert*	EX-PW-3A	2.3	2.9	0.9[2]
Bercot Rd. – 8" Outfall	EX-PW-14A	0.4	0.9	4.4
Bercot Rd. – 12" Outfall	EX-PW-15A	0.8	1.7	12.7
N. Cameron Rd. – 12" PVC S.D.*	EX-PW-7C	4.0	6.3	5.1
East Harbor Rd – 12" Culvert (EB-1)	EX-PE-1A	0.1	0.1	7.8
East Harbor Rd – 12" Culvert (EB-2)	EX-PE-2A	0.5	1.5	3.1

* Indicates culvert/pipe length and slope based on topographic survey data.

1. While modeling results indicates the Shoreview 18-inch outfall adjacent to Nichols Brothers is undersized, storage behind the inlet allows for approximately 3.3 feet of hydraulic head, which can result in as much as 20 cfs discharge at low tide. Historically, flooding overtops Shoreview Drive during an extreme high tide coinciding with a storm event because the road crown elevation very nearly matches the high tide elevation and the tide gates function intermittently.

2. A sag curve near the Woodard/Shoreview intersection is below the extreme high tide elevation resulting in periodic overtopping of Woodard Road. The Woodard Road culvert was constructed with a slight reverse slope (reducing full flow conveyance capacity) to allow for overflow from Wetland 4 to drain to the east side of Woodard Road. Modeling indicates that as the basin develops flooding will result.

4.5.2 Future Conditions

The 25- and 100-year storm events were routed through the three basin future condition models to calculate conveyance flow rates and capacities for full build out under future land use conditions (NMUGA zoning). Table 4-2 summarizes these results.

Table 4-2. Future Conditions Peak Discharge Rates for Key Conveyances

	Probability Storm Event Model Desig.	0.04 25-Yr Flow (cfs)	0.01 100-Yr Flow (cfs)	Full Flow Conveyance Capacity (cfs)
East Harbor Rd – 12" Culvert*	EX-PN-10A	10.9[1]	12.3[1]	8.3
Pleasant View Lane – 12" Culvert	EX-PN-11A	3.9	5.0	8.9
East Harbor Rd – 12" PVC S.D.*	EX-PN-4B	9.4[1]	12.2[1]	6.9
Main St. – 12" Culvert*	EX-PN-7A	2.8	3.5	4.9
Fish Rd. – 12" Culvert	EX-PN-10A	9.8[1]	12.9[1]	5.1
Shoreview Dr. – 18" Outfall*	EX-PW-4A	7.9	9.4	9.4
Shoreview Dr. – 18" Outfall*	EX-PW-5A	4.4	5.6	1.8
Woodard Rd. – 12" Culvert*	EX-PW-3A	9.9[1]	12.7[1]	0.9
Bercot Rd. – 8" Outfall	EX-PW-14A	3.7	5.1[1]	4.4
Bercot Rd. – 12" Outfall	EX-PW-15A	7.5	10.4	12.8
N. Cameron Rd. – 12" PVC S.D*.	EX-PW-7C	9.6[1]	12.2[1]	5.1
East Harbor Rd – 12" Culvert (EB-1)	EX-PE-1A	1.08[2]	1.4[2]	7.8
East Harbor Rd – 12" Culvert (EB-2)	EX-PE-2A	9.7[1, 2]	15.8[1, 2]	3.1

* Indicates culvert/pipe length and slope based on topographic survey data.
1 Indicates flooding during these events
2 Runoff discharges to private bluff property and will result in downstream flooding.

4.6 Offsite Basin Analysis

4.6.1 Basin W-19 Hydrologic Analysis

Basin W-19 is approximately 65.7 acres that drains southwest to Mutiny Bay. The proposed zoning within this basin is rural estate, which allows a density of one dwelling unit per acre. Vessel Court is an approved 6-acre PRD that lies within the basin; its density conforms to low density residential (three dwelling units per acre).

As this basin is developed, it assumed that Cameron Road will be completed through to Mutiny Bay Road and existing parcels will be subdivided into 1-acre parcels. The soils in this basin are HSG A with the exception of 1.9 acres at the north end of the basin (within Parcel S8290-00-00054-5). Because HSG A soils are infiltrative, this area was investigated as part of the Preliminary Infiltration Evaluation for wastewater disposal by TetraTech/KCM, Inc. Three test pits were excavated and soils samples were analyzed for grain size distribution. Long-term infiltration rates were estimated as 0.5 inches per hour.

There is no anticipated need for regional detention or regional water quality treatment in basin W-19. Soils mapping indicates that approximately two acres of Parcel S8290-00-00054-5 (adjacent to S.R. 525) may have HSG D soils, which has high runoff potential. As that parcel is subdivided, provisions for offsite infiltration or detention may have to be considered for lots with a preponderance of HSG D soils. It is recommended that Island County adopt the Roof Downspout Controls presented in the *Western Washington Stormwater Management Manual, 2001* (*Manual*). Based on the soils testing to date and zoning density, infiltration systems should provide sufficient runoff disposal for residential development in W-19. If Cameron Road is extended, roadside ditches/swales should be constructed and discharge to an infiltration pond constructed within the Island County right-of way. The pond should be sized to infiltrate road runoff generated from the newly constructed impervious area.

Roof downspout best management practices (BMPs) presented in the *Manual* are found in the Appendix – Volume 2.

4.6.2 Basin N-18 Hydrologic Analysis

As discussed Section 2.6.1, Basin N-18 is approximately 29.1 acres that drains east to Wetland 5, located between Newman Road and Scott Road. This is not a true drainage basin; N-18 represents only a small portion of a much larger basin that drains the wetland. The western boundary is defined by a drainage divide; the basins west of the divide drain to Holmes Harbor. The eastern boundary is simply the limit of the proposed NMUGA. Currently there are fourteen tax parcels within N-18. The proposed zoning is business general for twelve of the parcels and low density residential for the remaining two. At least nine of the parcels are undeveloped or can be developed at greater densities than currently exist.

Soils mapping indicates that approximately 3.8 acres of the basin zoned low density residential are an HSG C soil; the remaining 25.3 acres are typed as an HSG A soil. Five of the developed parcels have stormwater detention or retention systems. As the remaining parcels are developed, each will require runoff water quality treatment and stormwater detention. A closed depression analysis should be completed to quantify the detention requirements for a full build out condition.

SECTION 5.0 - PROBLEM IDENTIFICATION

5.1 Overview

Drainage problems within the Freeland area have been well documented in previous studies. A number of drainage improvement projects have been constructed that address conveyance and flooding issues. The purpose of this section is to:

- Summarize drainage recommendations from past studies.
- Summarize recent infrastructure improvements.
- Identify existing drainage problems.
- Identify future drainage infrastructure needs.

5.2 Previous Drainage Studies

5.2.1 *Freeland Community Drainage Basin Study* – Alpha Engineers Inc., 1985

The study area in this report was limited primarily to the area identified as the Central Basin. The report identified flooding in three areas: 1) Stewart Road and Freeland Park, 2) the intersection of Main Street and S.R. 525 and 3) the ditch system in, what is now, the Freeland Plaza parking lot. The report recommended the following actions:

a. Construction of a 30-inch storm drain line from Main Street north, through the area that is now the Freeland Plaza parking lot, to the existing drainage way behind Ace Hardware.

b. Construction of a cross culvert under S.R. 525 west of Harbor Avenue to direct runoff from a portion of the business district to the south side of the highway routing it to the wetland located at the southeast corner of the intersection of Fish Road and S.R. 525. The goal was to provide detention before discharging north (under the highway) through the 24-inch culvert to the Freeland Bog (Dinosaur Bog) at the northeast corner of the Main Street/S.R. 525 intersection.

c. Construction of a 24-inch storm drain line along Stewart Road to connect to the existing East Harbor system that drains a significant portion of the business district.

d. Construction of berms at Freeland Park to create a small levee to prevent flooding of the park at high tide.

5.2.2 *Island County Comprehensive Stormwater and Flood Hazard Management Plan* – KCM, 1997.

The Freeland study area addressed in this report was primarily the West Basin, citing flooding problems at Shoreview Drive, Ships Haven Drive and Bercot Road. This report recommended the following:

a. Upgrade the outfall near the intersection of Shoreview Drive and Cameron Road.

b. Upgrade the culvert at the intersection of Ships Haven Drive and Honey Moon Bay Road.

c. Install manhole and cross culvert at the intersection of Ships Haven Drive and Bercot Road.

d. Upgrade the Ships Haven Drive Outfall.

5.3 Recent Freeland Drainage Improvement Projects

5.3.1 Island County Public Works - Freeland Park Outfall Project

Island County initiated the Freeland Park Outfall project in August 1996 to address the problems in the Central Basin. The goal of the project was to alleviate the flooding problems discussed in the original 1985 study. Runoff from the business district, the Freeland Plaza and the south basins all drained to the ditch system on the south side of Stewart Road. Runoff was conveyed under Stewart Road through 24-inch and 36-inch culverts and discharges to Holmes Harbor through a culvert routed to a tide gate located in a catch basin structure. The tide gate is in disrepair and remains open, allowing the water surface elevation in the ditches to raise and lower with tidal action. When peak runoff from a storm event coincided with a high tide event, water over topped the ditch and flooded adjacent properties. One of the primary goals of the Freeland Park Outfall project was to provide a collection system for the north and south upstream basins that would bypass the Stewart Road ditch system and discharge directly to Holmes Harbor. Because of permitting and critical areas issues, the project was delayed until an alternate route for the main trunk line was finalized. This project was completed in the fall of 2004. A summary of the work completed follows:

Construction of approximately 1,240 feet of 30-inch and 140 feet of 36-inch storm drain from the Freeland Park running south along Myrtle Avenue then east on Dutch Hollow connecting to the existing 30-inch system within Freeland Plaza (behind Ace Hardware). The 36-inch line terminates in a new outfall vault that discharges to the beach at Freeland Park at the south end of Holmes Harbor. Additionally, 1,600 feet of 24-inch storm drain line was constructed along Stewart Road, beginning south of East Harbor Road and joining the 36-inch storm drain at the Myrtle-Stewart Road intersection. This 24-inch line connects to the existing drainage system from Main Street and East Harbor Road. Two in-line water quality treatment devices were also constructed as part of this project.

5.3.2 Freeland Senior Housing Project

Construction of 1,374 feet of 18-inch storm drain was constructed from the Freeland Senior Housing project west on Main Street to the intersection of Main and East Harbor Road. This project provided a stormwater outlet for Main Street properties east of Harbor Avenue. Additionally, the storm drain was upsized from 12-inch to 18-inch on the north side of Main Street between Harbor Avenue and East Harbor Road. This was a private development project. This project was completed in March, 1999.

5.3.3 Island County Public Works – Shoreview Drive Storm Drainage Improvements

This project consisted of construction of 338 feet of 18- and 24-inch storm drainpipe and a new 24-inch outfall vault located across from the Nichols Brothers boat ramp. This project alleviated flooding problems at the intersection of Cameron Road and Shoreview Drive. This work was completed in September, 2003.

5.3.4 Island County Public Works - Ships Haven Drive Drainage Project

Construction of approximately 800 feet of 24-inch storm drain from Honey Moon Bay Road, east across Bercot Road, terminating in a new 24-inch outfall to Holmes Harbor. This project provides increased capacity for approximately 80 acres (WB-17, WB-13 and WB-12) and alleviates flooding issues at the Ships Haven Drive and Honey Moon Bay and Bercot Road intersections. This work was completed in February, 2004.

5.4 Problem Identification Methodology

Problem areas were identified through: 1) interviews conducted with Island County Road District personnel (both Central and South Whidbey Road Shops) and 2) hydrologic modeling conducted for existing and future conditions for each basin to evaluate conveyance capacity and potential areas of flooding (Section 4-5). As a result of the capital improvement projects completed to date, the major flooding problems identified in the two earlier Freeland basin studies have been addressed.

5.4.1 Existing Problems

a. The Freeland Park Outfall Project: This project has a remaining phase (Phase 2) to be completed. The flow splitter (behind Ace Hardware) diverts base flow to the mapped stream #06-0010 stream north of Freeland Plaza. Due to topography, the 30-inch storm drain system serving Freeland Plaza upstream of the flow splitter is always surcharged because the outlet to the stream is higher than the pipe crown of the Freeland Plaza system. A primary goal of Phase 2 is to provide an outlet elevation sufficient to allow gravity flow through the Freeland Plaza system. The remaining work in Phase 2 will consist of three main components:

   1) Construction of approximately 450 feet of 12-inch PVC storm drain from the flow splitter (96-inch catch basin behind Ace Hardware). This distance

provides sufficient fall to allow gravity flow through the Freeland Plaza storm drain system to the mapped stream.

2) Stream improvements will be completed and will consist of creation of plunge pools and placement of woody debris to improve habitat in approximately 300 feet of streambed.

3) Determination of optimum water surface elevation (WSE) in the upstream wetlands identified as Wetlands #2 and #3 in Section 2. The flow splitter currently controls the water surface elevations in these wetlands at approximately 54.0 feet MSL. When gravity flow is established in the Freeland Plaza storm drain system, the invert elevation of the culvert under S.R. 525 will control the WSE in Wetland #2 and the inlet invert to of the culvert under Main Street will control the WSE in Wetland #3. If a higher WSE is desired, a weir should be constructed at or near the 24-inch culvert under Main Street to maintain the desired WSE (see Freeland Plaza Hydraulic Profile in Appendix – Volume 2).

b. East Basin: There are two 12-inch culverts (one in basin E-1 and one in basin E-2) that discharge onto private bluff property on the north side of East Harbor Road; there are no outfalls to convey this discharge over the bluff. The future conditions model predicts flows through these culverts for the 100-year storm event as 3.4 cfs and 15 cfs, respectively. Island County will need to obtain drainage easements and construct one or possibly two outfalls to prevent downstream flooding of private property as development proceeds in the East Basin.

5.4.2 Potential Drainage Problems – Identified by Hydrologic Modeling

The 25 and 100-year, 24-hour storm events were routed through each of the basin models for future conditions. Conveyance capacity and headwater elevation in existing structures were evaluated for surcharge conditions. Fifteen problem areas are discussed on the following pages with associated mapping to identify the location of problem areas. The reach (culvert, pipe or ditch) designation used in the StormShed model is referenced in the problem description and the various figures to key it to the conveyance modeling.

<u>Problem #1</u> (Figure 5-1)

Basin: Central (Conveyance)

Location: East Harbor Road and Stewart Road: 12-inch cross culvert

Problem: Future conditions model predicts existing 12-inch culvert capacity is exceeded during 25-year, 24-hour storm event.

Solution: Replace existing culvert with an 18-inch culvert.

Model Reach Designation: EX-PN-10A

<u>Problem #2</u> (Figure 5-1)

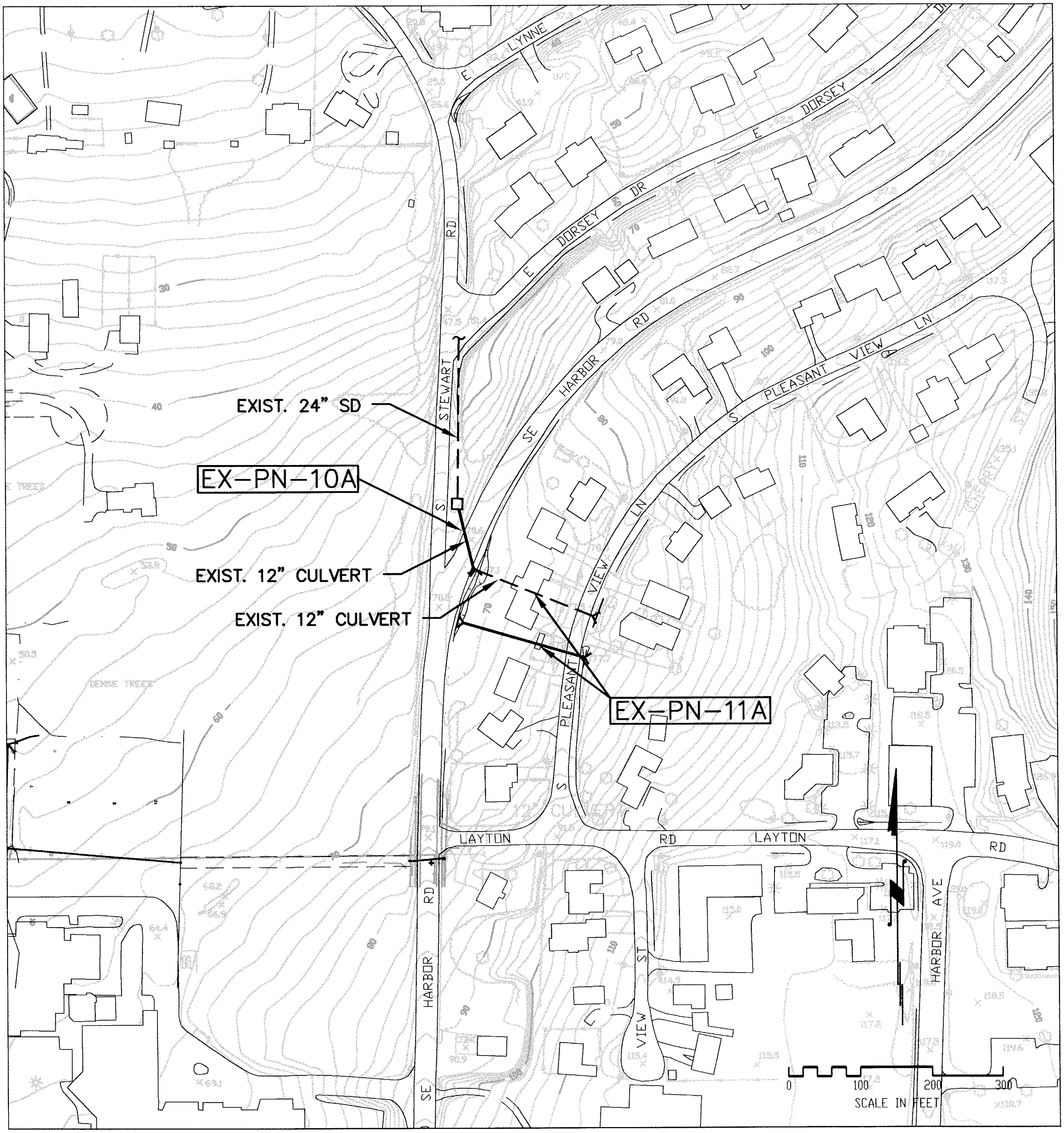
Basin: Central (Conveyance)

Location: Pleasant View Lane and East Harbor Road: 12-inch culvert

Problem: The culvert that transports runoff from Pleasant View Lane to the ditch on the south side of East Harbor Road passes under an existing residence (Lot 5 East Harbor Terrace).

Solution: The ditch on Pleasant View should be regraded and a new 12-inch culvert constructed along a common property line and a drainage easement conveyed to Island County.

Model Reach Designation: EX-PN-11A



1. REPLACE 12" CULVERT UNDER EAST HARBOR ROAD, EX-PN-10A, WITH 18" CULVERT.
2. ABANDON EXISTING 12" CULVERT UNDERNEATH RESIDENCE ON LOT 4/5, BLOCK 1 OF EAST HARBOR TERRACE, EX-PN-11A, AND CONSTRUCT NEW 12" CULVERT PARALLEL TO LOT LINE AND CREATE DRAINAGE EASEMENT.

CENTRAL BASIN

FIGURE 5-1

1" = 200'

<u>Problem #3</u> (Figure 5-2)

Basin: Central (Conveyance)

Location: East Harbor Road - Main St to Layton Rd: Existing 12-inch storm drain

Problem: The Main Street system, upstream, has been upsized to 18-inch PVC. Future conditions model predicts capacity of the existing 12-inch system is exceeded during 25-year, 24-hour storm event.

Solution: The remaining 630-foot section of 12-inch pipe should be upsized to 18" PVC.

Model Reach Designation: EX-PN-4B

<u>Problem #4</u> (Figure 5-2)

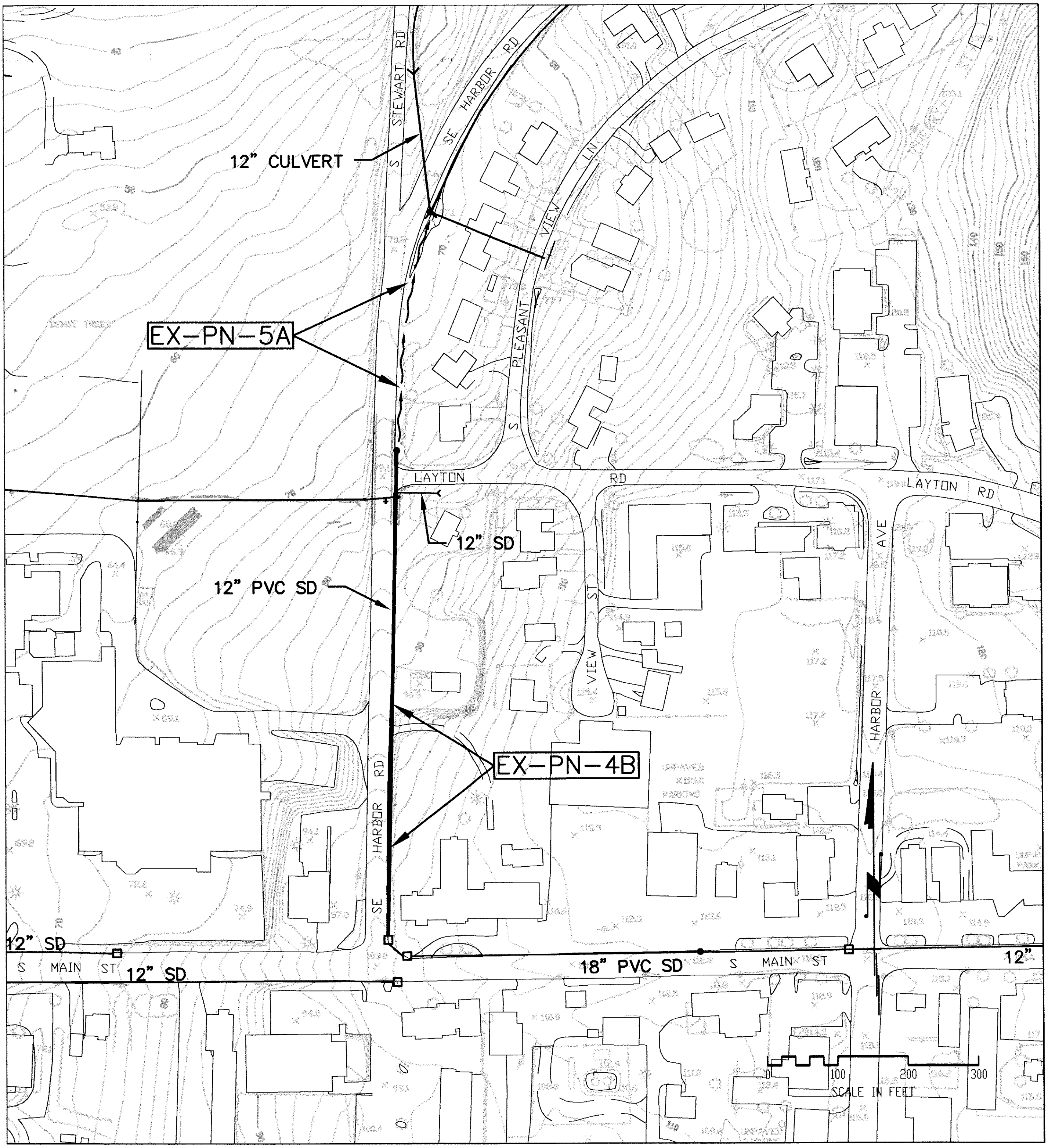
Basin: Central (Water Quality)

Location: East Harbor Road north of Layton Road: Existing ditch

Problem: There is no bio-filtration runoff treatment downstream of the business center. Additionally, water quality sampling from the commercial district has indicated stormwater runoff is low in dissolved oxygen.

Solution: The ditch north of Layton could be regraded to form a bio-filtration swale with 3:1 side slopes and 2.5-foot bottom for greater capacity. Turbulent flow in the open swale will provide aeration of the runoff, as well as, runoff treatment.

Model Reach Designation: EX-PN-5A



1. REPLACE APPROXIMATELY 630' – 12" PVC SD, EAST SIDE OF SOUTH EAST HARBOR ROAD, EX-PN-4B, WITH 18" PVC.

2. UPGRADE EXISTING DITCH, EAST SIDE OF EAST HARBOR ROAD, EX-PN-5A INTO BIO-FILTRATION SWALE.

CENTRAL BASIN

FIGURE 5-2
1" = 200'

<u>Problem #5</u> (Figure 5-3)

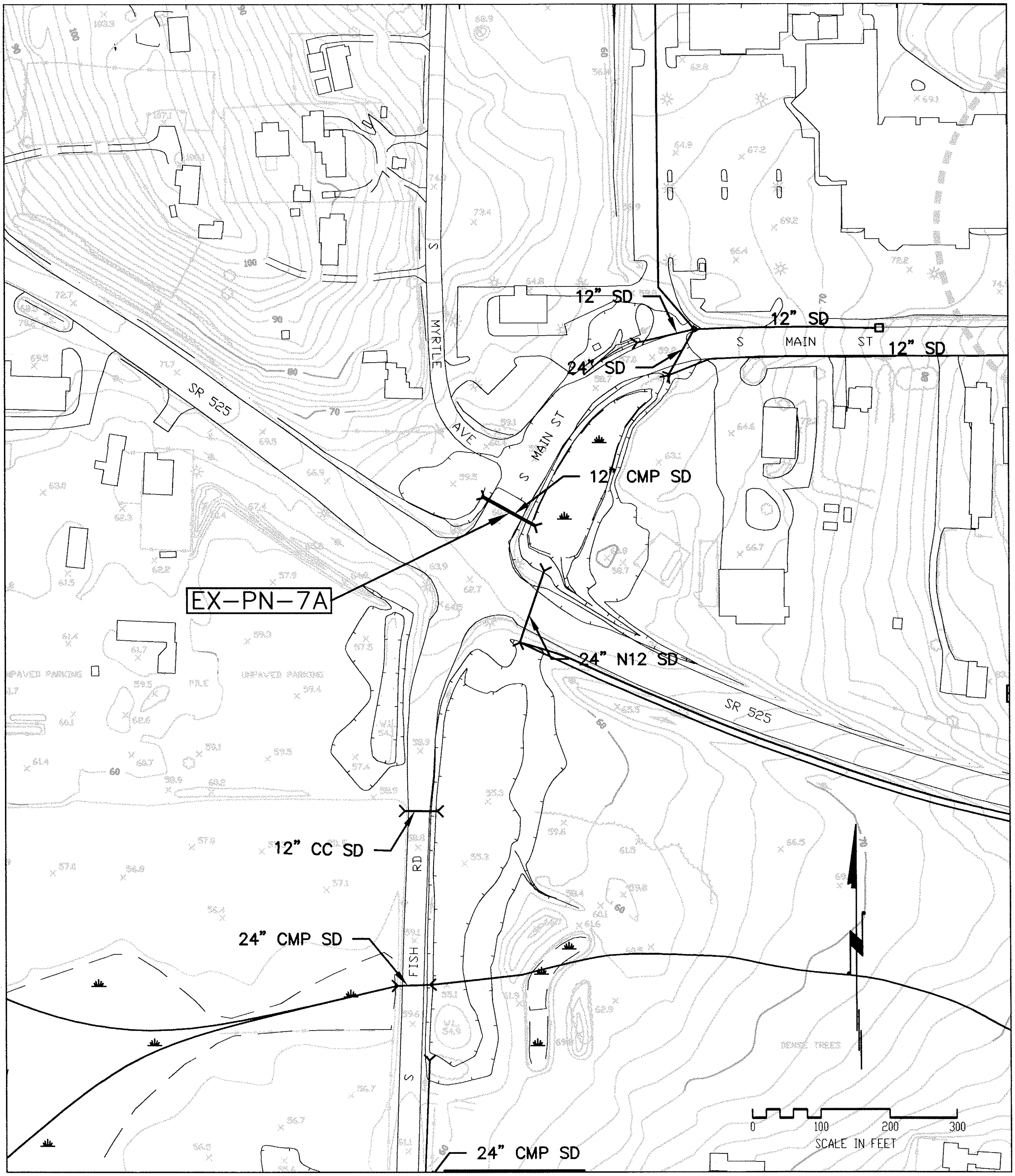
Basin: Central

Location: Main Street at the intersection of S.R. 525: Existing 12-inch culvert

Problem: Future conditions model predicts capacity of 12-inch culvert is sufficient for both the 25- and 100-year, 24-hour storm event, but it is Island County's policy is to upsize culverts to a minimum of 18-inches for maintenance purposes.

Recommendation: Replace 12-inch culvert with an 18-inch culvert when future roadwork is necessary at the Main Street/S.R. 525 intersection.

Model Reach Designation: EX-PN-7A



1. REPLACE 12" CULVERT, UNDER S. MAIN STREET, NORTH OF SR 525, $\boxed{\text{EX-PN-7A}}$, WITH 18" CULVERT.

CENTRAL BASIN

FIGURE 5-3

1" = 200'

<u>Problem #6</u> (Figure 5-4)

Basin: Central (Conveyance and Water Quality)

Location: Fish Road east of Woodard Ave.: Existing ditch

Problem: Existing ditch that conveys runoff to 12-inch cross culvert may be undersized, based on field inspection.

Solution: The ditch should be regraded to increase capacity. If elevations are favorable, this should be constructed as a bio-filtration swale with 3:1 side slopes, providing for runoff treatment prior to discharge to the wetland north of Fish Road.

Model Reach Designation: EX-PS-2A

<u>Problem #7</u> (Figure 5-4)

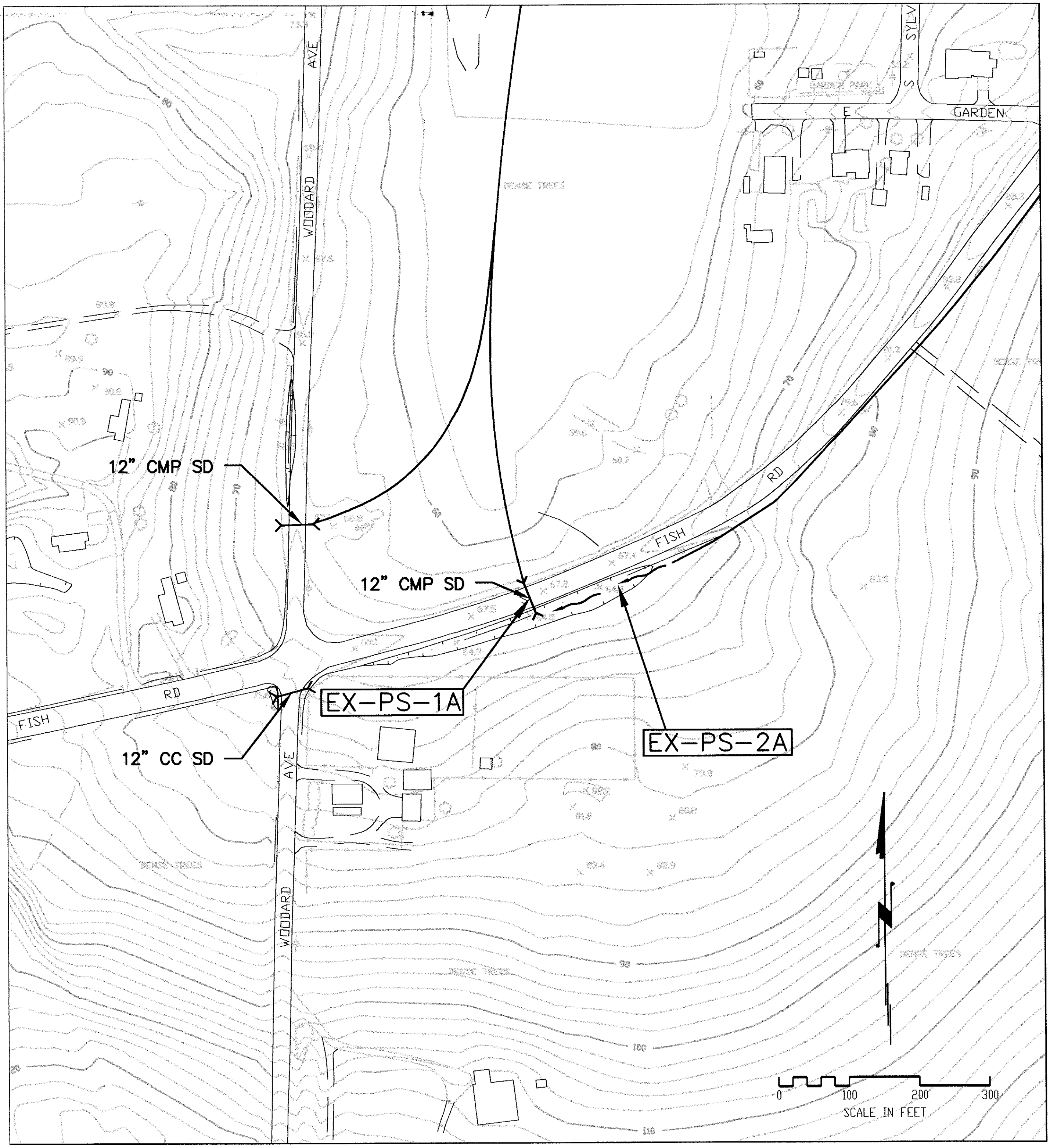
Basin: Central

Location: Fish Road east of Woodard Ave.: Existing 12-inch culvert

Problem: Future conditions model predicts existing capacity of 12-inch culvert that discharges to the north side of Fish Rd. is exceeded during 25-year, 24-hour storm event.

Solution: Replace existing culvert with an 18-inch culvert.

Model Reach Designation: EX-PS-1A



1. IMPROVE/UPGRADE APPROXIMATELY 200 FT OF EXISTING DITCH, SOUTH SIDE OF FISH ROAD, EX-PS-2A .

2. REPLACE 12" CULVERT, UNDER FISH ROAD, EX-PS-1A , WITH 18" PVC.

CENTRAL BASIN

FIGURE 5-4

1" = 200'

Problem #8 **(Figure 5-5)**

Basin: West

Location: Shoreview Dr. east of Nichols Brothers Boatyard

Problem: There are two 18-inch outfalls along Shoreview Drive, one drains the wetland just to the west of Woodard Avenue and the other drains the ditch system and detention pond for the Nichols Brothers Boatyard. The tide gates for both outfalls intermittently jam open due to barnacle buildup on the flap gate mechanisms and sand buildup at the outlet inverts. Because the tide gates function intermittently, the water surface elevation in the wetland and Shoreview ditch system is influenced by tidal action. When an extreme high tide coincides with a large storm event, peak runoff from a storm event causes over topping of Shoreview and Woodard and flooding of adjacent properties.

Solution: Replace existing outfalls with 18-inch smooth bore pipe and replace and re-locate tide gates within catch basin structures at the inlet end of pipes to facilitate maintenance.

Model Reach Designation: EX-PW-4A and EX-PW-5

Note: This solution is proposed as a near term structural improvement to restore the tide gate functions to both outfalls and provide easy access for maintenance. It does not include alternative designs such as, an open channel culvert or construction of fish passable tide gates.

Problem #9 **(Figure 5-5)**

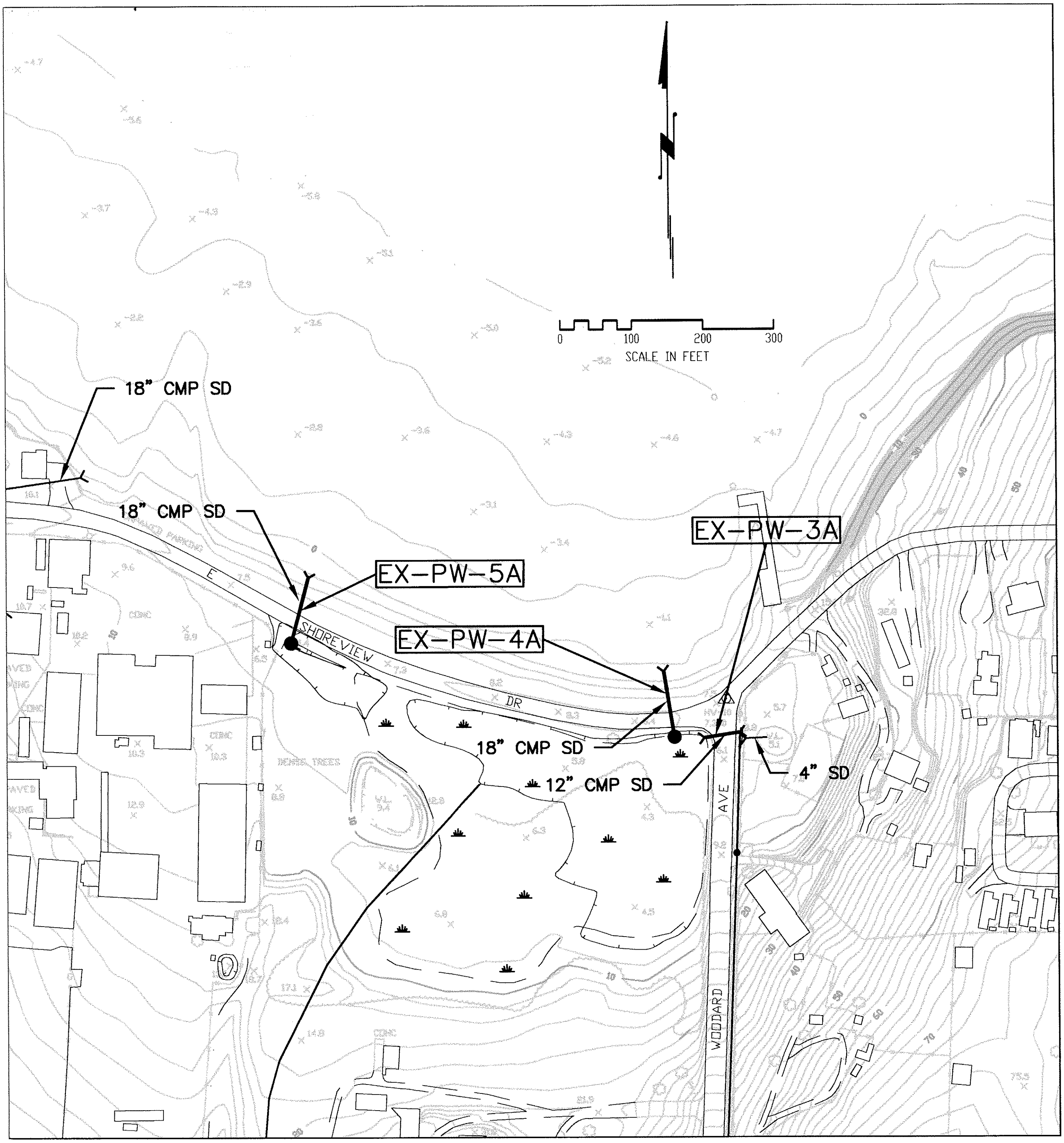
Basin: West

Location: Intersection of Shoreview Dr. and Woodard Ave.: Existing culvert

Problem: Future conditions model predicts existing capacity of 12-inch culvert under Woodard Ave. is exceeded during 25-year, 24-hour storm event.

Solution: Replace existing culvert with 18-inch culvert.

Model Reach Designation: EX-PW-3A



1. REPLACE EXISTING OUTFALL EX-PW-5A WITH SMOOTH BORE 18" PIPE AND INSTALL NEW TIDE GATE AT PIPE INLET INSIDE 60" MANHOLE.
2. REPLACE EXISTING OUTFALL EX-PW-4A WITH SMOOTH BORE 18" PIPE AND INSTALL NEW TIDE GATE AT PIPE INLET INSIDE 60" MANHOLE.
3. REPLACE EXISTING 12" CULVERT UNDER WOODWARD AVENUE WITH 18" CULVERT EX-PW-3A .

WEST BASIN

FIGURE 5-5

1" = 200'

<u>Problem #10</u> (Figure 5-6)

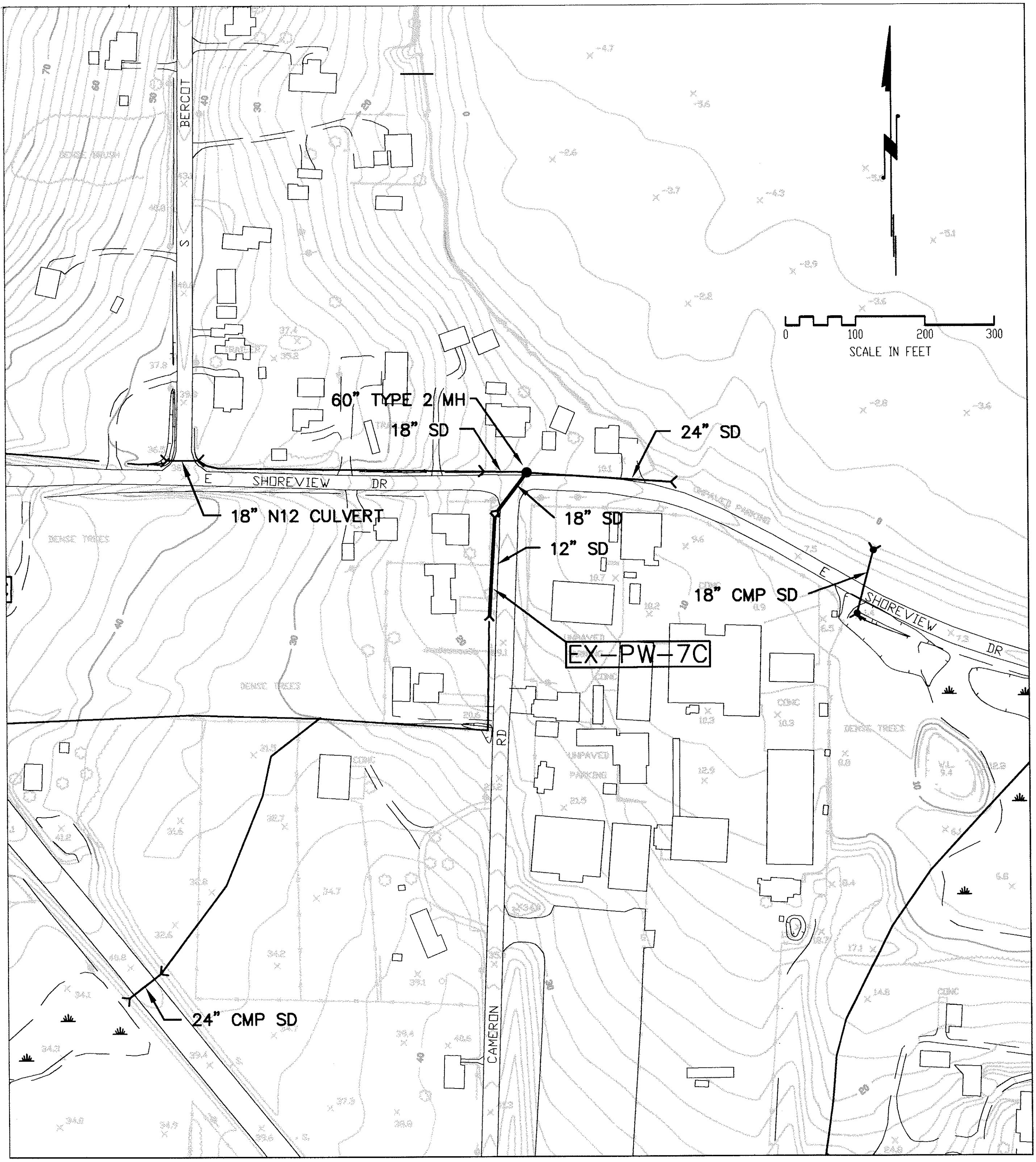
Basin: West

Location: Cameron Road: Existing 12-inch PVC storm drain

Problem: Future conditions model predicts capacity of this line is exceeded during 25-year, 24-hour storm event, resulting in flooding at inlet along Cameron Road.

Solution: Replace existing storm drain with 140-feet of 18-inch PVC storm drain.

Model Reach Designation: EX-PW-7C



1. REPLACE APPROXIMATELY 140 FT OF EXISTING 12" STORM DRAIN WEST OF SOUTH CAMERON ROAD $\boxed{\text{EX-PW-7C}}$ WITH 18" PVC PIPE.

WEST BASIN

FIGURE 5-6

1" = 200'

<u>Problem #11</u> (Figure 5-7)

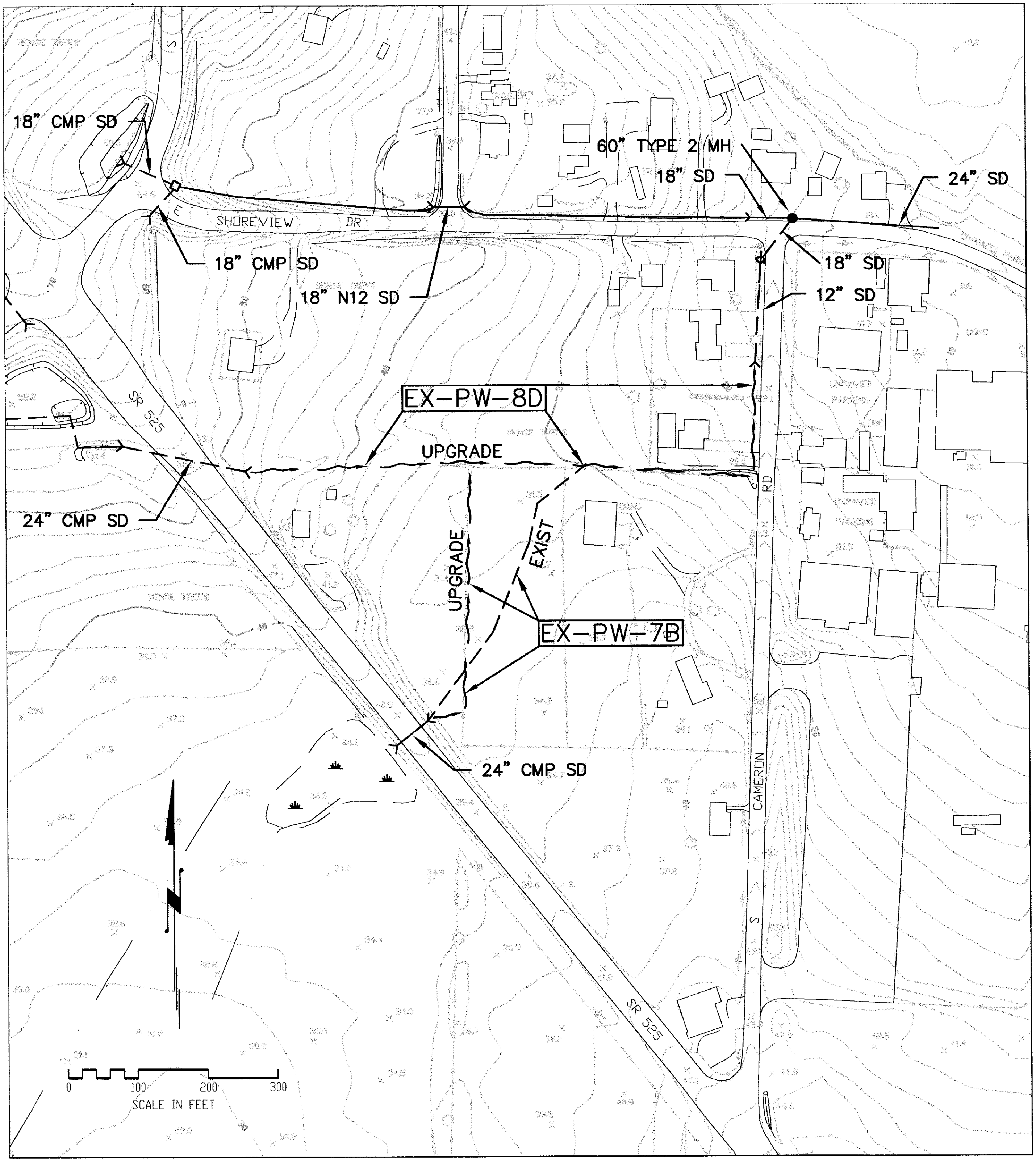
Basin: West (Conveyance and Water Quality)

Location: S.R. 525 between Cameron Road and Honey Moon Bay Road: Existing ditches

Problem: Two 24-inch culverts transport runoff under S.R. 525 between Honey Moon Bay Road and Cameron Road. They discharge to two ditches that convey runoff to the Cameron Road drainage system. Should there be increased development upstream of these culverts, the ditches may not be able to convey the increased flow and area flooding is a possibility.

Solution: As upstream development increases, ditches should be regraded and improved. There may be opportunities for construction of bio-filtration swales to provide runoff treatment prior to discharge to the Cameron Road drainage system.

Model Reach Designation: EX-PW-7B and EX-PW-8D



1. UPGRADE/IMPROVE DITCHES EX-PW-8D AND EX-PW-7B .

WEST BASIN

FIGURE 5-7

1" = 200'

<u>Problem #12</u> (Figure 5-8)

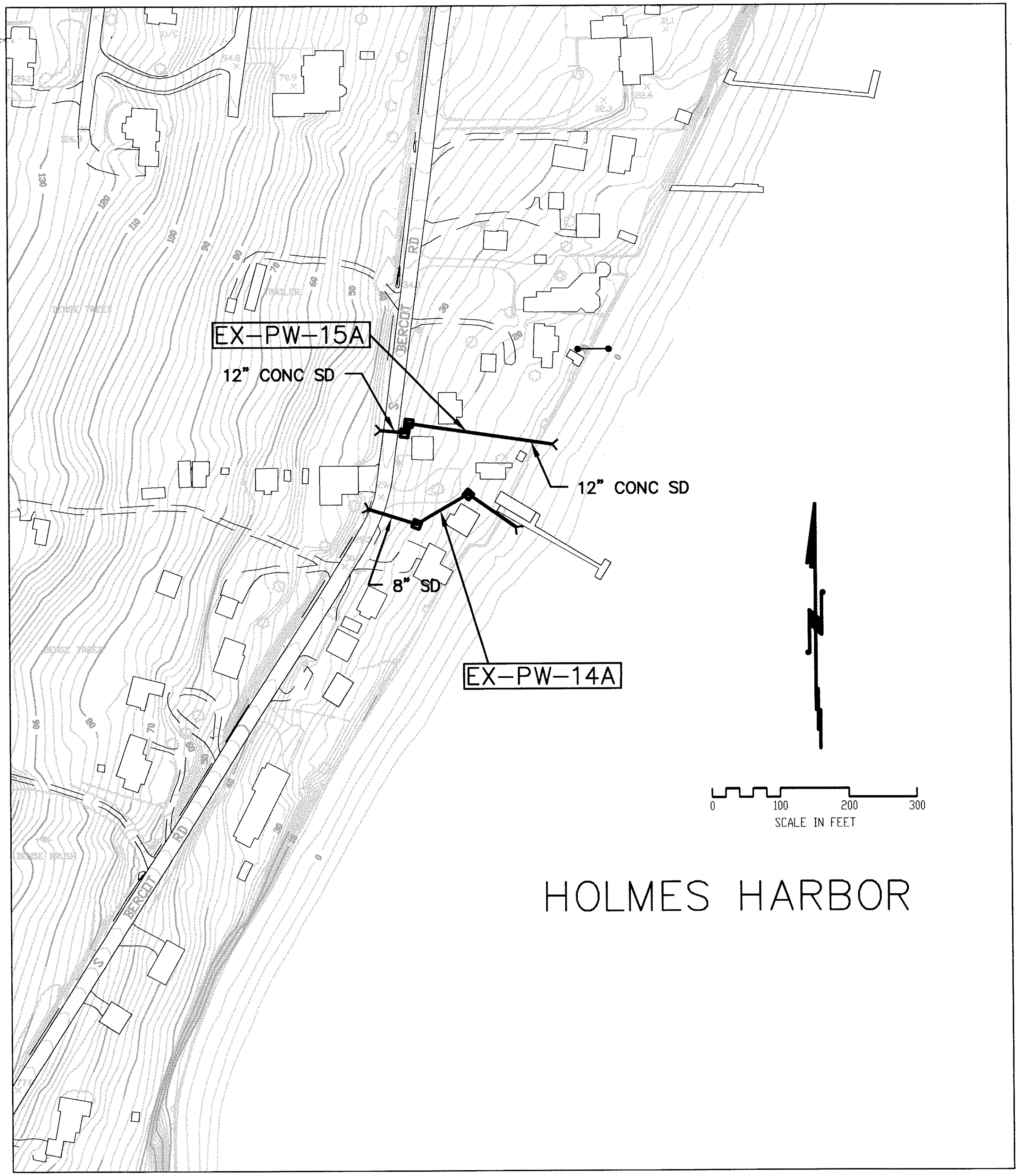
Basin: West (Conveyance and Maintenance)

Location: Bercot Road: Existing 12-inch and 8-inch outfalls

Problem: The low point in Basin W-15 is drained by a 12-inch outfall. The low point in Basin W-14 is drained by an 8-inch outfall; these outfalls are located approximately 150 feet apart. The 8-inch storm drain is exceeded during the 100-year, 24-hour storm event, which may result in flooding at inlet along Bercot Road.

Solution: Combine two outfalls into a single 18-inch outfall pipe. Drainage easements should be formalized to enable ongoing maintenance.

Model Reach Designation: EX-PW-14A and EX-PW-15A



1. RECOMMEND COMBINING 12" CONCRETE OUTFALL EX-PW-15A AND 8" OUTFALL EX-PW-14A INTO ONE COMMON OUTFALL.

WEST BASIN

FIGURE 5-8

1" = 200'

<u>Problem #13</u> (Figure 5-9)

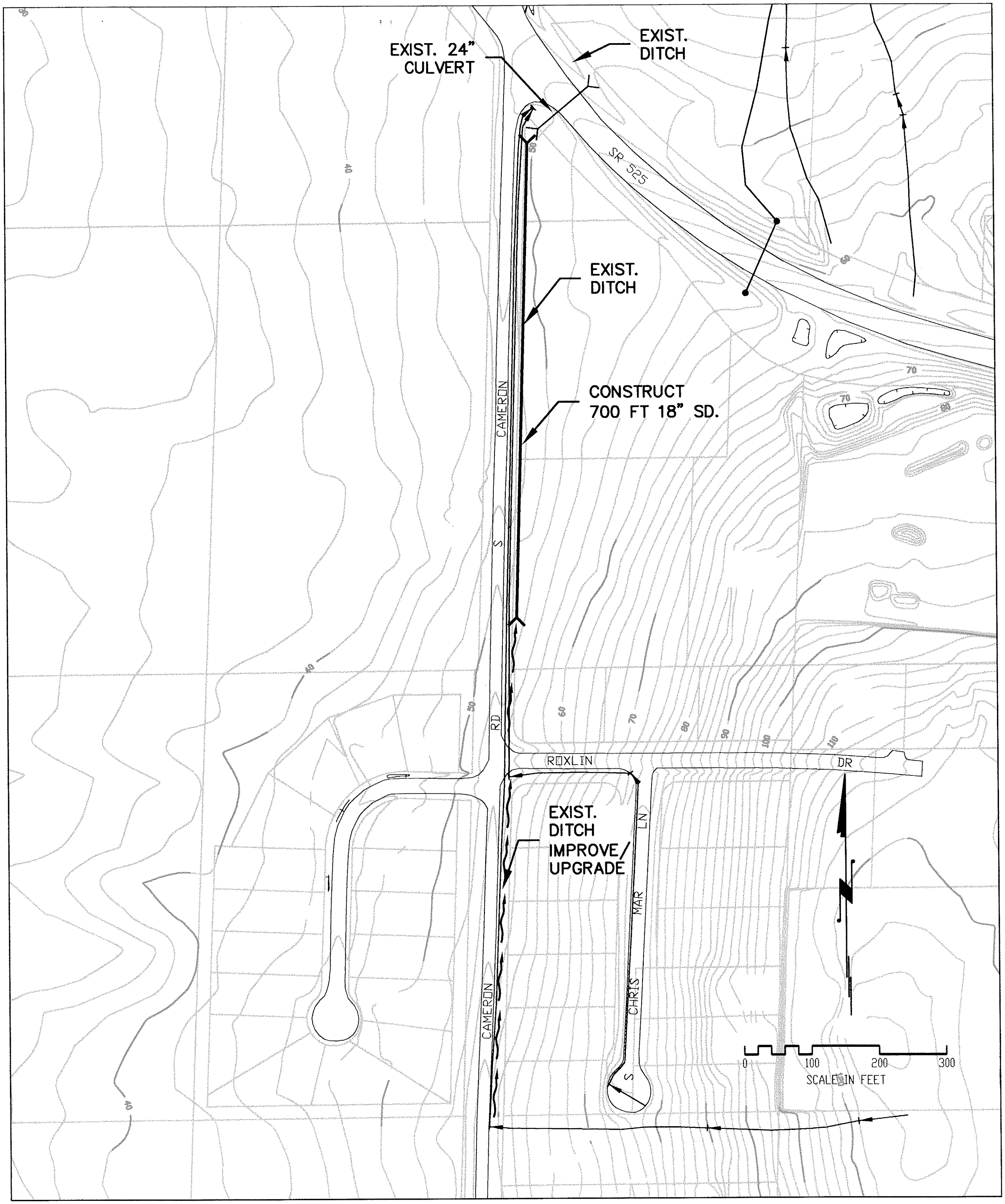
Basin: West (Conveyance)

Location: Cameron Road south of S.R. 525: Existing ditch on east side of Cameron Road

Problem: Because of grade changes within the ditch flow line; ditch runoff is not able to gravity flow north to the S.R. 525.

Solution: Grade approximately 750 feet of ditch south of Roxlin Drive and install approximately 700 feet of 18-inch PVC storm drain line to enable runoff to gravity flow to the 24-inch culvert under S.R. 525.

Model Reach Designation: Reach not included in original model. Preliminary conveyance sizing completed using the uniform flow analysis method.



1. IMPROVE/UPGRADE APPROXIMATELY 750 FT OF EXISTING DITCH, EAST SIDE OF CAMERON ROAD.
2. INSTALL 700 FT OF 18" SD, EAST SIDE OF CAMERON ROAD.

WEST BASIN
FIGURE 5-9
1" = 200'

<u>Problem #14</u> (Figure 5-10)

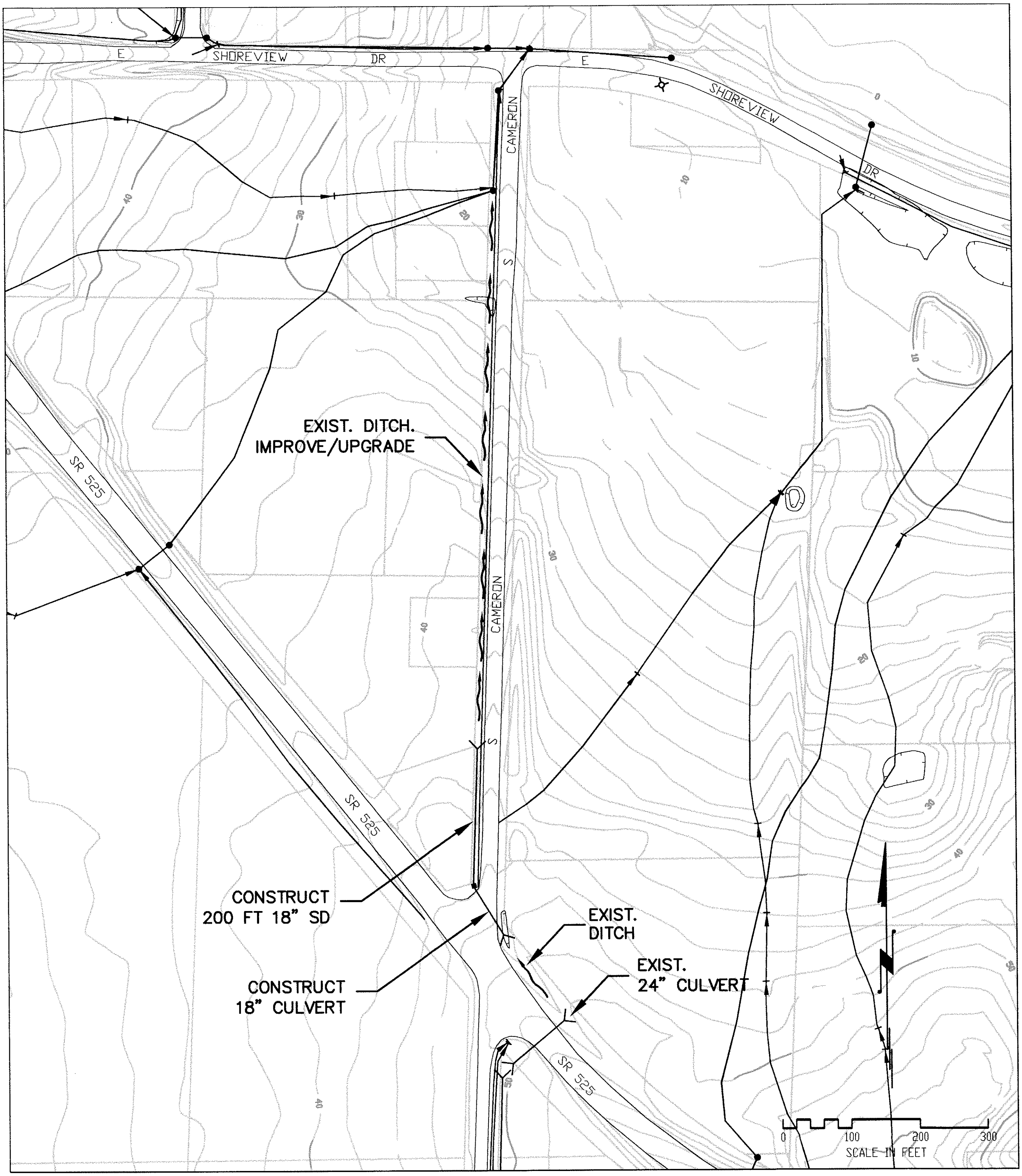
Basin: West (Conveyance)

Location: Cameron Road north of S. R. 525: West side of Cameron Road

Problem: There is no drainage infrastructure to convey runoff from the 24-inch culvert under S.R. 525 to the existing ditch and storm drain system on the north end of Cameron Road.

Solution: Construct an 18-inch culvert under Cameron Road (north of S.R. 525) to convey discharge from existing 24-inch highway culvert to the west side of Cameron Road. Install catch basin and 200 feet of 18-inch storm drain to bridge existing parking lot. Improve and re-grade approximately 800 feet of existing ditch on west side of Cameron Road to connect to existing system.

Model Reach Designation: Reach not included in original model. Preliminary conveyance sizing completed using the uniform flow analysis method.



1. INSTALL 80 FT OF 18" SD, UNDER CAMERON ROAD.
2. INSTALL 200 FT OF 18" SD, WEST SIDE OF CAMERON ROAD.
3. IMPROVE/UPGRADE APPROXIMATELY 800 FT OF EXISTING DITCH, WEST SIDE OF CAMERON ROAD.

WEST BASIN

FIGURE 5–10
1" = 200'

Existing Problem (Figure 5-11)

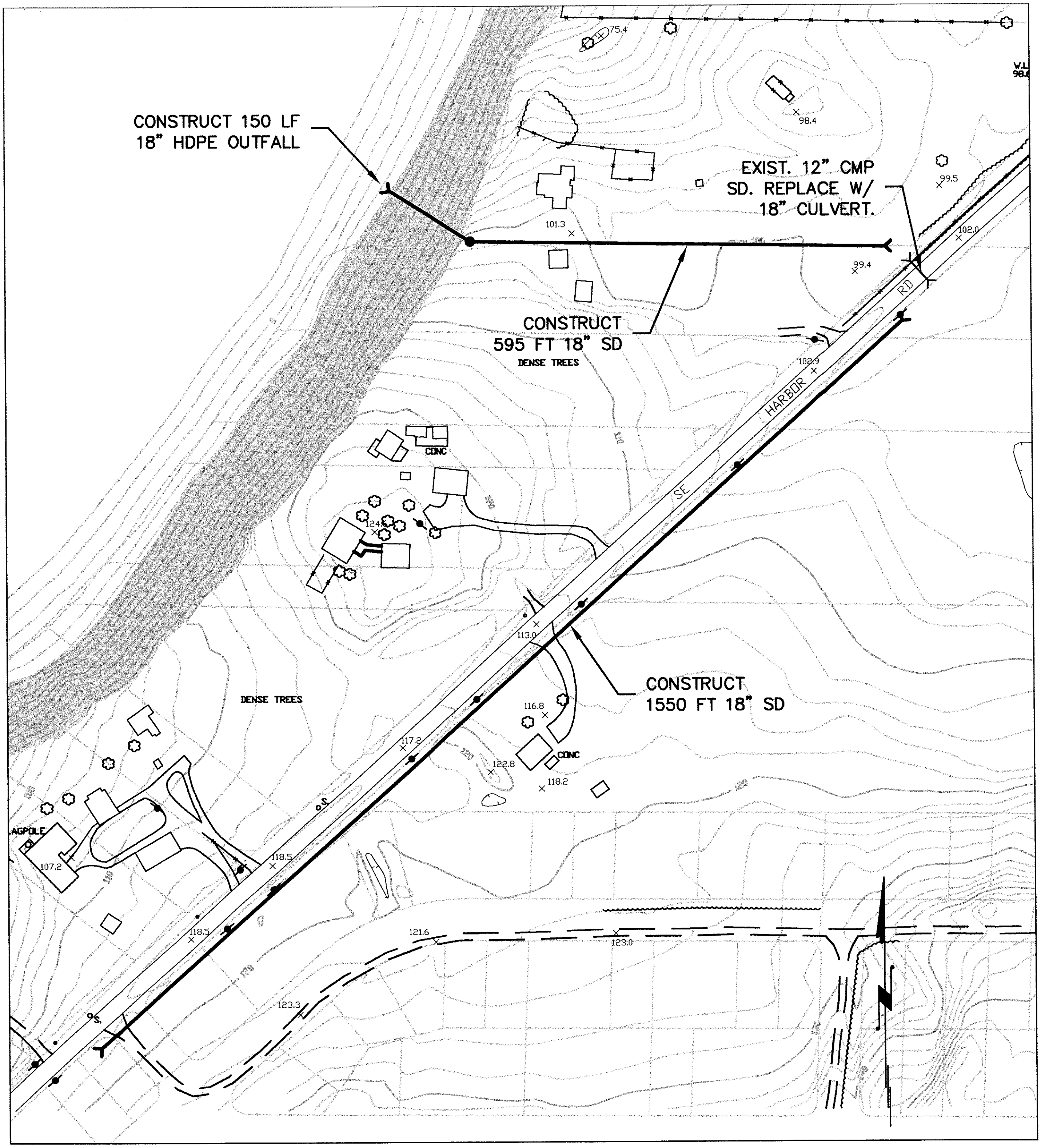
Basin: East

Location: S. East Harbor Road north of Whispering Firs Sub division

Problem: A single 12-inch culvert under East Harbor Road in basin E-2 discharges runoff onto private, high bluff property. The future conditions model indicates the 12-inch culvert capacity is exceeded for the 24-hour, 25-year storm event and the increased flow poses a potential flood hazard to the downstream property owner. Additionally, projected development within the Plat of Whispering Firs may increase runoff to a 12-inch culvert in Basin E-1 that discharges to Lot 10 in Hazens Beach.

Solution: Upsize existing 12-inch culvert in Basin E-2 to an 18-inch culvert. Construct approximately 595 feet of 18-inch storm drain line from East Harbor Rd to the bluff and construct 150 feet of 18-inch outfall to convey culvert discharge to Holmes Harbor. Combine Basins E-1 and E-2 by constructing 1,550 feet of 18-inch storm drain line along East Harbor Rd. to convey runoff from basin E-1 to the newly constructed culvert and outfall in basin E-2.

Model Reach Designation: Reach not included in original model. Preliminary conveyance sizing completed using the uniform flow analysis method.



1. REPLACE EXISTING 12" CULVERT UNDERNEATH SE HARBOR ROAD WITH 18" CULVERT.

2. INSTALL 1550 LF 18" SD WITH CATCH BASINS.

3. INSTALL 595 LF 18" SD.

4. INSTALL 150 LF 18" OUTFALL.

0 100 200 300
SCALE IN FEET

EAST BASIN
FIGURE 5–11
1" = 200'

5.5 Recommendations for Stormwater Control

Stormwater management in the Freeland area falls within the purview of Island County and is regulated in accordance with the following regulations; ICC 11.02 - Clearing and Grading, ICC 11.03 -Stormwater Management Ordinance and the Island County Stormwater Design Manual and ICC 17.02 – Critical Areas Ordinance. These regulations cover the following elements

- Stormwater controls for new development and redevelopment.
- Site plan review
- Erosion and sediment control during construction
- Inspection of construction-sites
- Maintenance of permanent stormwater facilities
- Low impact development practices
- Wetland protection

5.5.1 Stormwater Discharge Control

The existing stormwater regulations in effect for both residential and commercial development are adequate for protecting downstream properties and guarding against the negative impacts of stormwater discharge. ICC 11.03.210 requires additional surface water quantity and water quality controls in Urban Growth Area (UGA) and those Rural Areas of Intense Development (RAIDS) that have been designated Critical Drainage Areas. The Freeland business district currently falls within that designation. The stormwater improvements already completed in the Central Basin provide for collection and discharge of stormwater runoff. Therefore, it is not necessary to provide stormwater quantity controls for new development or redevelopment in the north basins, which comprise the business center. A lifting of the Critical Drainage Basin designation should be considered. Water quality treatment will still be required for new development and re-development projects.

5.5.2 Stormwater Quality Overview

Water Quality Standards for Surface Waters of the State of Washington (Chapter 173-201A WAC) stipulates quantitative water quality requirements for discharge to both marine and fresh water surface waters. It is written primarily from a wastewater perspective in which a National Pollutant Discharge Elimination System discharge permit (NPDES permit) would specify the maximum concentrations allowed for various contaminants of concern in the wastewater discharge. Water quality samples are taken at intervals specified in the permit and results monitored to determine if the treatment meets the required permit limits. In general the water quality standards are less stringent for discharge to marine waters than to fresh water.

While stormwater is considered wastewater, stormwater quality is not monitored in the same manner; it is managed through a "presumptive" policy. The Department of Ecology (through its *Stormwater Management Manual*) has identified specific water quality treatment best management practices (BMPs) that are required for various sources of stormwater runoff. A stormwater BMP, if constructed and maintained, is "presumed" to meet State water quality standards. This provides a straight forward approach to treatment selection for new development and redevelopment projects. In cases where there are documented stormwater quality problems the selection of a BMP that will attain a specific water quality standard is not as straight forward because stormwater treatment technologies are still maturing. Additional research is required to document the effectiveness of stormwater BMPs to treat specific pollutants. In some cases current stormwater technology may not be able to attain State water quality standards. Data suggests that there is a background limit or irreducible concentration for each contaminant that represents the lower limits that current technology will be able to achieve. The challenge for stormwater management is to implement effective water quality strategies that are both affordable and effective.

5.5.3 Current Stormwater Quality

Herrera Environmental Consultants completed three reports within the Central Basin in support of the water quality best management practices (BMP) design for the Freeland Park Outfall project. These reports include an *Existing Habitat Study*, *Water Quality Assessment Report* and *Stormwater Treatment and Final Project Report*. Water quality monitoring stations were placed in four locations within the Central basin (see Figure 5-12). Station 1 is located at the inlet to Wetland 3, and provides an indication of water quality discharged from Wetland 2, as affected by highway runoff at the intersection of S.R. 525 and Main Street. Station 2 receives runoff directly from Freeland Plaza, in addition to upstream runoff from Wetland 3. Station 4 receives runoff primarily from the commercial district adjacent to Main Street, Harbor Avenue and Layton Road. Runoff from Stations 2 and 4 are conveyed directly to Holmes Harbor through newly constructed storm drain lines along Stewart Road and Myrtle Avenue.

The study concluded that based on comparisons to published data, the areal loading rates of pollutants discharged to Holmes Harbor from the Freeland basin were extremely low. With that as a backdrop, the report found a number of water quality concerns.

- Fecal coliform contamination was pervasive in the Central Basin and the primary contaminant of concern.
- Dissolved copper and zinc found primarily at Stations 2 and 4 (commercial areas) were found to be a significant water quality problem during storm flow.
- Dissolved oxygen and pH showed violations of State water quality standards at Stations 1 and 2.

Fecal coliform contamination can originate from a number of sources. It may reflect failing septic drainfields, illicit sewage discharge to the storm drain system or pet, agricultural or wildlife waste entering stormwater stream. Copper and zinc sources include insecticide and fungicide applications, corrosion of metal flashing and tire and break lining wear. The low dissolved oxygen and pH probably reflect stagnant water conditions in the contributing wetlands and the Freeland Plaza storm drain system, which currently operates as a pressure system.

5.5.4 Water Quality Recommendations

Water quality recommendations fall into two categories, those that address the specific water quality issues identified in the Central Basin from recent water quality monitoring and those recommendations for future stormwater management for the Freeland area.

(1) Central Basin Water Quality Recommendations – Existing Water Quality

a) Fecal coliform contamination is recognized as a major concern. It is estimated that to meet the water quality standard of 200 CFU/100mL that urban stormwater treatment would have to achieve a 99% removal rate. Standard stormwater BMPs such as wet ponds or sand filters yields an average of 50 to 60% removal, which falls far short of the standard. A less expensive and potentially more effective solution may be source control; identifying and correcting the source of fecal contamination. It is recommended that Island County pursue grant funding through the Centennial Clean Water Fund to complete a microbial tracking study to analyze the source of the fecal contamination. Once the source is identified there are a number of options that could be implemented (depending on the source) from inspection and correction of failing drainfields to public education regarding pet waste or agricultural livestock waste management. Construction of sanitary sewer system and treatment facility may also reduce or eliminate fecal contamination, if the source is determined to originate from failing drainfields.

b) Dissolved copper and zinc were highlighted as a significant problem at Stations 2 and 4. Four of sixteen samples taken at Stations 2 and 4 exceeded the acute marine water quality standard for dissolved copper, while three of sixteen samples exceeded the standard for zinc. Source control is, again, recommended as a first step. Street and parking lot sweeping, cleaning of catch basin sumps, covering dumpsters, washing commercial vehicles at commercial car wash facilities and consideration of eliminating sources of zinc, such as zinc flashing and prohibition of galvanized products in municipal projects are ways to control the sources of potential contamination.

c) The low pH and low D.O levels experienced at Stations 1 and 2 stem from stagnant water resulting in chemical reducing conditions, which is common for wetland water quality. When Phase 2 of the Freeland Park Outfall project is implemented, it will lower the outlet elevation of the storm drain system through the Freeland Plaza allowing gravity flow and natural mixing in the storm drain the system. This will introduce oxygen downstream of Station 1 and will result in increased D.O levels at Station 2. A side benefit of aeration is the possible reduction of CO_2 (a by product of chemical reduction) resulting in an increase in pH.

d) Utilize bio-filtration and bio-retention BMPs where possible in the commercial district to improve water quality. In the structural problem identification section (Section 5.3) one of the recommendations is to construct a bio-filtration swale downstream of Station 4. It is one of the few opportunities to provide biological treatment in an otherwise closed storm drain system. Bio-swales have proven effective in removing suspended solids, dissolved metals and nutrients. Additional biological treatment can also be introduced in redevelopment projects. Required landscape areas can be designed to perform bio-filtration or bio-retention functions.

(2) Central Basin Regional Water Quality Treatment

Two proprietary treatment devices were installed as part of the Freeland Park Outfall project. A Bay Saver Model 3K separation system was installed along Myrtle Avenue as an in-line treatment device in the 30-inch storm drain system; a Vortechs Model 9000 treatment system was installed for in-line treatment in the 24-inch storm drain system along Stewart Road. Both these devices were sized for the water quality design storm event (6-month 24-hour storm) for full build out in the future conditions model; both are sedimentation devices for the treatment of suspended solids (TSS). While water quality monitoring data indicated relatively low TSS concentrations in the existing water quality, these concentrations are expected to increase as development increases. Additionally, many contaminants bind themselves to suspended particulate matter in stormwater runoff and TSS removal has the potential to reduce overall pollutant loadings by removing bound metals and nutrients. A water quality monitoring program should be instituted downstream of each device to assess their performance.

(3) Freeland Basin Water Quality Recommendations – Future Water Quality

In general, implementation and enforcement of the existing regulations is sufficient to protect future water quality within the Freeland basin. In addition to the above, two areas should be emphasized.

a) Source control strategies should be implemented in the business and commercial areas. Local businesses should be inventoried to determine possible contamination sources and a public education effort implemented so that the benefits of source control on water quality are well understood. For example, recent water quality monitoring data indicated a relatively high concentration of motor oil at only Station 4. This may be the result of one or more businesses in which there is an illicit or unknown connection of a floor drain to the storm drain system, a poor containment system during an oil spill or simply poor housekeeping and maintenance practices. Through an on-site inventory potential sources of contamination can usually be identified. Other high payoff maintenance practices include parking lot and street sweeping and catch basin sump cleaning that should be part of an active source control program.

b) Greater emphasis on low impact development (LID) practices in the existing commercial areas for new development and redevelopment have the potential for protecting and improving water quality. LID practices incorporated in rural and rural residential areas are relatively easy to implement and will also reduce the sediment and pollutant loads that reach wetlands and marine waters. Two thirds of the Freeland basin area falls within the rural or rural residential category and, therefore, the cumulative effect of LID improvements, such as, infiltration or bio-retention systems are significant.

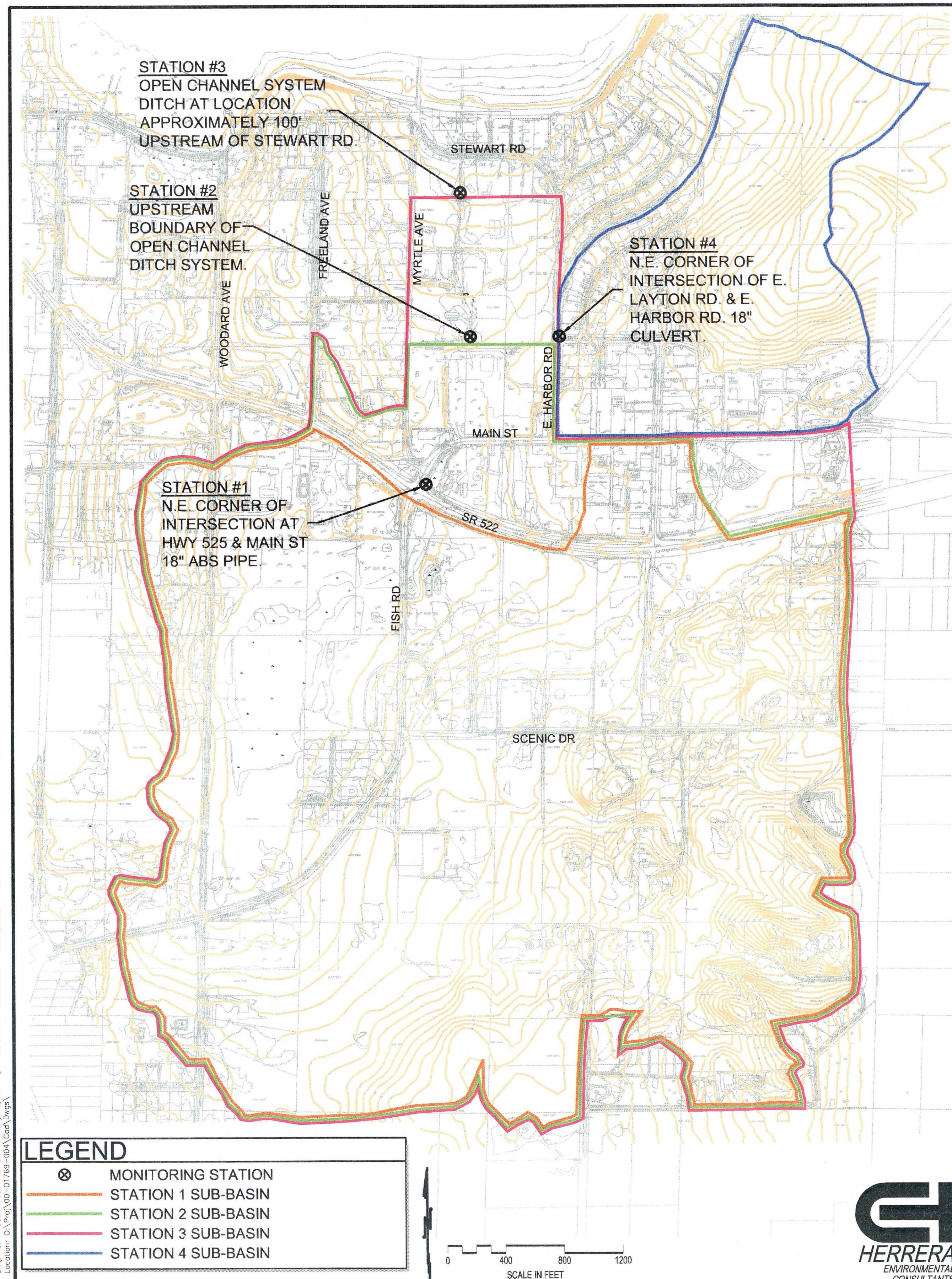


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Figure 5-12 Water quality monitoring stations and associated sub-basins for the Freeland Water Quality Monitoring Project.

SECTION 6.0 - PLAN RECOMMENDATIONS

6.1 Overview

The capital improvement plan provides basic information for improving stormwater conveyances. These drainage improvements are needed to address potential flooding and stormwater quality as Freeland continues to develop. This plan lists sixteen projects. They include two existing problems, Phase 2 of the Freeland Park Outfall and the need for an East Basin Outfall. Additionally, hydrologic modeling identified fourteen projects or potential projects that are necessary to preclude flooding, as the Freeland basin develops.

Project 1 (Existing Problem) **Project Cost: $115,100**
Freeland Park Outfall – Phase 2, which includes 450 feet of 12-inch PVC storm drain and 320 feet of stream enhancements and improvements for mapped stream #06-0010.

Project 2 (Existing Problem) **Project Cost: $275,000**
Replace culvert under East Harbor Road with an 18-inch culvert, construct approximately 595 feet of 18-inch CPE storm drain and an 18-inch outfall (150 feet) with diffuser tee. Construct 1,550 feet of 18-inch CPE along East Harbor Rd. Secure necessary drainage easements.

Project 3 (Problem 1) **Project Cost: $9,200**
Replace cross culvert under East Harbor Road at the Stewart Road intersection with 18-inch culvert.

Project 4 (Problem 3) **Project Cost: $96,600**
Upgrade 630 feet of 12-inch PVC to 18-inch PVC on East Harbor Road between Main Street and Layton Road. This project includes curb and gutter and asphalt repair along the length of the storm drain.

Project 5 (Problem 4) **Project Cost: $14,000**
Replace existing ditch on east side of East Harbor Road with 350 lineal feet of bio-filtration swale between Layton Road and Stewart Road.

Project 6 (Problem 8) **Project Cost: $58,800**
Replace existing outfalls on Shoreview Drive with 18-inch smooth bore pipe and replace and re-locate tide gates within catch basin structures at the inlet end of pipes to facilitate maintenance. This proposal does not include construction of fish passable tide gates.

Project 7 (Problem 9) **Project Cost: $9,200**
Replace cross culvert under Woodard Avenue at the Shoreview Drive intersection with 18-inch culvert.

Project 8 (Problem 5) **Project Cost: $12,100**
Replace cross culvert under Main Street at the S.R. 525 intersection with 18-inch culvert.

Project 9 (Problem 12) **Project Cost: $76,900**
Combine two outfalls (12-inch and 8-inch) located on the west side of Bercot Road into a single 18-inch storm drain and outfall (approximately 270 feet).

Project 10 (Problem 10) **Project Cost: $23,400**
Upgrade 140 feet of 12-inch PVC to 18-inch PVC on Cameron Road at the intersection of Shoreview Drive.

Project 11 (Problem 11) **Project Cost: $19,300**
Improve approximately 1,000 lineal feet of drainage ditch that conveys runoff from south side of S.R. 525 to the Cameron Road drainage system; construct 300 lineal feet of bio-filtration swale within this system.

Project 12 (Problem 14) **Project Cost: $48,400**
Construct an 18-inch culvert under Cameron Road (north of S.R. 525) to convey discharge from existing 24-inch highway culvert to the west side of Cameron Road. Install catch basin and 200 feet of 18-inch storm drain to bridge existing parking lot. Improve and re-grade approximately 800 feet of existing ditch on west side of Cameron Road to connect to existing system.

Project 13 (Problem 13) **Project Cost: $85,400**
Improve and re-grade approximately 750 feet of existing ditch south and north of Roxlin Drive on east side of Cameron Road; install approximately 700 feet of 18-inch PVC storm drain line to enable runoff to gravity flow to the 24-inch culvert under S.R. 525.

Project 14 (Problem 2) **Project Cost: $18,100***
Replace 12-inch culvert between Pleasant View Lane and East Harbor Road from under residence on Lot 4/5 Block 1 of East Terrace with an 18-inch culvert and relocate to a common property line; regrade ditch to direct runoff to new culvert location.
* Project cost depends on negotiations with affected property owners and does not include replacement costs for landscaping, fencing, etc.

Project 15 (Problem 6) **Project Cost: $12,300**
Replace existing ditch on south side of Fish Road just east of Woodard Avenue with 200 lineal feet of bio-filtration swale that discharges to cross culvert under Fish Road.

Project 16 (Problem 7) **Project Cost: $9,200**
Replace cross culvert under Fish Road just east of Woodard Road with 18-inch culvert.

These projects have an estimated total project cost of $883,100. In addition, there are associated annual maintenance and operational costs (O&M) to be determined. Maintenance is completed by Island County's Central and South Road District personnel. An internal audit is necessary to determine current O&M costs a projection for O&M costs associated with these future improvements.

6.2 Capital Improvement Plan

6.2.1 Six-Year Planning Window

The Capital Improvement Plan (CIP) is a prioritized budget for the implementation of the recommended structural improvements. It is prepared as tool for Island County Public Works to prioritize work with available funding, taking into account the severity or importance of the problem. It can also be used as a planning tool in establishing baseline funding requirements if a municipal or surface water entity is formed (such as, a drainage district or surface water utility) to implement the CIP.

Because of the major drainage improvement projects that have been completed in the West and Central basins, modeling results for existing conditions did not highlight any immediate capacity or flooding problems in the drainage system in these basins. There are, however, no stormwater outfalls in the East basin. Modeling highlighted the need for at least one outfall as development proceeds in the near term.

The recommended projects are summarized in Table 6-1. Phase 2 of the Freeland Park Outfall project falls within the six-year window; it was given the highest priority because it is an on going project with water quality implications. Project 2, in the East Basin, is a high priority project because of the potential for downstream flooding. Three projects that drain the business district along S. East Harbor Road are recommended to be included in this window, as well. The 12-inch storm drain on S. East Harbor Road has excess capacity up to and including the 100-year storm event for the existing condition, but the existing condition includes stormwater detention and retention for many of the properties within the business district that are now able to discharge to the Main Street – East Harbor drainage system. Recent stormwater improvements may encourage increased development in the business core. Therefore, it is recommended that the capacity improvements along S. East Harbor Road (Projects 3 & 4) be completed before detention facilities are abandoned. Runoff water quality from the business district (Station 4) has been noted previously. Project 5 should be included in the six-year planning window as it may provide for near-term water quality improvement.

6.2.2 Twenty-Year Planning Window

The future conditions modeled a full build out scenario; there was no projection made as to when this may occur. For this reason, the remaining projects are listed in the twenty-year planning horizon. An implementation strategy for these projects could be linked to a percentage of build out in the respective basins and available funding. A simpler strategy could be to simply wait until there is a need, through evidence of occasional flooding or capacity problems.

It is recognized that the Island County Road crews are capable of completing any or all of the remaining projects. The relative ease with which some of these projects could be constructed, coupled with the low capital cost could influence the priority in which some projects are completed. For example, a culvert replacement may be more likely to be completed before a higher priority but higher capital cost project. The remaining projects for the twenty-year planning horizon are listed in Table 6-1.

Cost estimates developed for structural improvements included a mobilization allowance of 10%, sales tax of 8.3%, a construction contingency of 25% and engineering/surveying and permitting fees of 25%. Costs are based on 2004 dollars.

Table 6-1 does not include annual operations and maintenance (O&M) costs. These are currently born by the Central and South, Island County Road Districts.

6.3 Funding Options

6.3.1 Overview

Island County currently maintains oversight of surface water management in the Freeland area and has been the funding source for the majority of stormwater projects. To implement the CIP, however, the establishment of drainage district or surface water utility should be explored. A number of options are available including:

1. Drainage District Formation: The creation of a drainage district would provide funding for capital projects and operations and maintenance of facilities. RCW 85.06 "Drainage District" and RCW 85.38 "Special District Creation and Operation" outline district creation, special assessments, management and district powers. Creation of a district can be initiated through a petition process or resolution of the county legislative authority. The proposal then goes through a public hearing process. If the district proposal goes to election, a simple majority vote is required to form the district. The Freeland Water District could take the lead in initiating the public education and petition process necessary for district formation. The boundaries of the district could coincide with the water district boundaries or a larger district could be formed.

2. Surface Water Utility: RCW 36.89 provides authority for the Board of County Commissioners to establish a surface water utility that encompasses all of Island County or a smaller regional area. This utility would generate revenue through a rate system that could be administered by the Public Works Department. Because of the public concern regarding additional taxes, it is envisioned that the BOCC would require an election and simple majority vote to authorize the creation of a surface water utility.

The construction and maintenance of regional and local stormwater water quality and infrastructure requirements exceed available Island County funding on an annual basis. A local drainage district or surface water utility has the ability to raise revenue, as well as, manage, fund and prioritize stormwater projects that meet local needs and reflect local priorities. If a district encompasses a large enough area the shared cost per tax parcel is minimized.

A surface water utility has a service area and fee generating area that is usually defined, in large part, by the hydrologic boundaries. If a surface water utility is formed, it should be noted that the Freeland watershed basin boundaries do not coincide with planning area boundaries. Stormwater runoff from the proposed NMUGA has the potential for downstream impacts to the Mutiny Bay area and the closed depression bounded by Scott and Newman Roads to the east. For this reason the boundary for the surface water entity may have to exceed the proposed NMUGA boundary to encompass these downstream areas or there will have to be inter-local agreements established between the surface water entity and Island County to manage stormwater that discharge to these areas.

6.3.2 Capital Improvement Projects' (CIP) Funding Sources

Island County stormwater funding for CIP work is provided from the Road Fund and the Real Estate Excise Tax Fund (REET1 and 2), or through project specific sources. If a surface water entity were formed, utility rates and connection fees would provide additional revenue sources.

1. **Road and REET Funding**: Stormwater projects related to road runoff and road design are generally funded by the Road Fund and REET funds. Maintenance of stormwater infrastructure within County right-of-way or County drainage easements is funded solely by the Road Fund. The source of the Road Fund is through state tax on gasoline and diesel fuels. Capital projects for storm and surface water funded by the Road Fund have to serve a road purpose (e.g. replacement of a failing culvert). Capital projects that replace a structurally sound culvert that is undersized generally are funded from both the Road Fund and the REET funds. RCW 82.45 imposes an excise tax on every real estate sale at the rate of 1.28% of the selling price. RCW 82.46 authorizes counties and cities to impose additional taxes on these sales in the form of two, 0.25% taxes, referred to as REET1 (first one quarter percent) and REET2 (second one quarter percent). REET1 funds are available for general capital projects that are listed in the capital facilities element of the comprehensive plan. REET2 funds are available for growth related capital projects and the replacement or improvement of capital facilities.

2. **Utility Service Charges**: Utility rates apply to a drainage district or surface utility. They are often assessed based on impervious area coverage or as a flat fee. Percentage of impervious cover is generally considered more equitable because the fee is based on stormwater runoff contribution and allocates a higher charge to

properties that benefit most. The rate would be set based on percentage of estimated or measured impervious area per parcel. Impervious area is that area occupied by the building footprint and pavement. The downside to an impervious cover rate structure is that it is harder to administer and more labor intensive as it requires a method of impervious area calculation, which normally requires a site visit for field verification.

3. **Connection charges or System Development Fees**: These charges apply to a drainage district or a surface water utility. This charge allows a utility to recoup the construction costs for stormwater infrastructure that was necessary to support the additional runoff generated by the new development.

4. **Project Specific Funding Sources**:

   a. **Fee in Lieu of Construction**: The charge allows the surface water authority to offer the developer the option of 1) constructing necessary infrastructure, or 2) contributing to a fund that will support future construction of a necessary regional facility. If a fee-in-lieu-of approach is adopted it must be closely managed to ensure the required regional facility or infrastructure is in service in time to keep pace with the development projects approved under this process.

   b. **Developer Extension and Latecomer Agreements**: This funding mechanism allows developers to construct required surface water infrastructure or improvements that are necessary to support their project approval (generally downstream or regional improvements). The developer is then able to recoup a fair share of these infrastructure costs through a latecomer's agreement that assesses property owners when they ultimately develop and connect to the system and take advantage of the built in additional capacity.

   c. **Local Improvement District (LID) or Utility Local Improvement District (ULID)**: The use of an LID to fund surface water projects has not been widely used, locally, because of the difficulty in quantifying the benefit to individual property owners. It can be expensive to set up because it requires a special benefit study or appraisal, bond counsel, an LID administrator and significant public education and involvement to garner support for the LID.

   d. **Grant Funding**: The Department of Ecology administers three water quality programs including the Centennial Clean Water Fund, the State Revolving Fund and the Section 319 Nonpoint Source Grants Program (Section 319). There are no grants available at this time for CIP projects.

Table 6-1 Capital Improvement Projects

Project	Problem No.	Figure No.	Model Reach Desig.	Description	Cost	Priority
1	Existing	---	---	Phase 2 Freeland Park Outfall	$115,100	6-year
2	Existing	5-11	---	East Harbor Rd – Construct 18-inch Outfall & Storm Drain	$275,000	6-year
3	1	5-1	EX-PN-10A	East Harbor Rd – Upsize Culvert	$9,200	6-year
4	3	5-2	EX-PN-4B	East Harbor Rd – 630 LF 18-inch Storm Drain Upsize Culvert	$96,600	6-year
5	4	5-2	EX-PN-5A	East Harbor Rd – Construct Bio-filtration Swale	$14,000	6-year
				Sub Total	**$509,900**	---
6	8	5-5	EX-PW-4A EX-PW-5A	Shoreview Dr. – Replace Outfalls & Tide Gates	$58,800	20-year
7	9	5-5	EX-PW-3A	Woodard Ave. – Upsize Culvert	$9,200	20-year
8	5	5-3	EX-PN-7A	Main St. – Upsize Culvert	$12,100	20-year
9	12	5-8	EX-PW-14A EX-PW-15A	Bercot Rd. – Combine Existing Outfalls into Single 18-inch Outfall	$77,000	20-year
10	10	5-6	EX-PW-7C	Cameron Rd. –140 LF of 18-inch Storm Drain	$23,400	20-year
11	11	5-7	EX-PW-7B EX-PW-8D	Ditch Improvements - S.R. 525 to Cameron Rd	$19,300	20-year
12	14	5-10	---	Cameron Rd N. of S.R. 525 – 200 LF of 18-inch Storm Drain & Ditch Improvements	$48,400	20-year
13	13	5-9	---	Cameron Rd S. of S.R. 525 – 700 LF of 18-inch Storm Drain & Ditch Improvements	$85,400	20-year
14	2	5-1	EX-PN-11A	Pleasant View – Relocate and Upsize Culvert	$18,100	20-year
15	6	5-4	EX-PS-2A	Fish Rd. - Construct Bio-filtration Swale	$12,300	20-year
16	7	5-4	EX-PS-1A	Fish Rd. - Upsize Culvert	$9,200	20-year
				Sub Total	**$373,200**	---
				Total	**$883,100**	---